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CHINA REPORT
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NATIONAL DEVELOPMENTS

PROBLEMS VIEWED IN CURRENT SCIENCE RESEARCH MANAGEMENT

Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 3, Jul 82
pp 1-7

[Article by Lu Jiaxi [4151 0857 6932] of the Chinese Academy of Sciences:
"Several Problems Concerning Current Scientific Research Management*"]

*Editor: This article is an abstract of a speech given by the writer at the
Planning Conference of the Chinese Academy of Sciences

[Text] I. Strengthening Academic Leadership

The fourth membership conference of the academic department held last May was an important step toward reforming the leadership system and strengthening academic leadership. But, in specifically changing from administrative leadership to academic leadership, there is still a lot of work to do. One very important point is to develop academic democracy and strengthen the academic legal system. The democratic and legal systems we are talking about share common points with other areas but they are not entirely the same. In our scientific research units, developing democracy and strengthening the legal system mean to reorganize the order of scientific research, improve scientific research management, make regulations and systems sound, create an academic environment, develop discussion between the same professions, enliven the academic atmosphere, and shape a tradition of contest.

In strengthening academic leadership, we must fully develop academic democracy and form a production academic atmosphere. Facts prove that without academic democracy, there will not be a production academic atmosphere, and there will not be any academic leadership. We have realized in the experience of the past several years that discussion between the same professions is a good way to develop academic democracy and an important measure to strengthen academic leadership. In the first time after the fourth membership conference of the academic department, we grasped the work of evaluating the research institutes and we achieved better results. Doing this enabled scientists gradually to propose constructive opinions concerning major academic problems. The research institutes that were evaluated all felt that this was very helpful. We gained a more profound understanding of how research institutes carry out academic leadership through the evaluation of the research institutes. But, up to the present, each academic department has only evaluated one or two research in-

stitutes. The progress of evaluation should be hastened. Each academic department can divide the research institutes of its own system into categories, and then select one research institute from each category for evaluation. In this way, one evaluation can solve the problems of several research institutes. Of course, at present, our evaluation of the same professions is still not perfect. There are still some problems, but evaluation is always better than not evaluating them. Through recent work in evaluating the same professions, including the evaluation of research institutes, the academic atmosphere has become more productive than before. We have realized the function of developing academic democracy and strengthening academic leadership, and we pushed scientific research work forward.

Truly to strengthen academic leadership, we must consider problems academically. From a strategic viewpoint, we must change the past way of relying only on administrative meetings to decide problems. For this, we must reform current scientific research management methods. Beginning from this year, we will change the previous method of managing scientific research funds. One important aspect is to give support by "selecting the important" and "selecting the superior." Giving support by "selecting the superior" is to give support to those academic leaders and research subjects that have a relatively high academic level and academic thought. Giving support by "selecting the important" is to support those research topics that can solve key scientific and technical problems in the national economy and in national defense buildup. "The superior" and "the important" do not exist independently. They must be combined. To select "the superior" and "the important" well, we must rely on strengthening academic leadership and improving the level of academic leadership. The methods of managing the key subjects supported by the institutes, and "superior" and "important" subjects must also be changed. In general, we must consider "basing our efforts on success." One is that we must have near-term and long-term goals. The second is that we must have a definite time limit. In general, the efforts should show results or should be completed within 3 to 5 years. The "nonsense" subjects that do not produce a result for a dozen years or several decades must not be supported. Of course, "basing efforts on success" or completing efforts within a time limit mainly refers to applied research and developmental work. It is very difficult to require basic research to be completed within a time limit, but we should have plans and arrangements so that progress is realized in each stage and results with definite meaning are realized (it would be best if expected results are achieved). If all projects can realize this, then it would prove that the standard of academic leadership has been elevated. Another renovation in managing scientific research funds is that starting from this year, our academy will implement monetary assistance by the Science Fund of the Chinese Academy of Sciences. This is a fund oriented toward the whole nation. The amount of evaluating work is large. The time limit for schedules completion of projects seeking funding should be shortened. Generally, they should be required to produce results within 2 to 3 years. At present, we are studying the actual methods or review. The funds for projects supported in a key way by our academy this year amount to 40 million yuan. The science fund has 30 million yuan this year. After gaining experience, we must increase the amount of funds for projects with key support, increase the proportion of funding and reduce the proportion of contract work to stimulate everyone to think; and we must solve the problem of "eating from the big pot." Another aspect in renovating scientific

research management is that we should change the current method of controlling and using large instruments and equipment. Now, we have a lot of equipment that has broken down not because of use but because it has been left unused or shutdown and not used, thus causing great waste. In order to be responsible to the state and fully develop the function of large instruments and equipment, I believe, we should build comprehensive laboratories at some of the institutes that have relatively complete research equipment not just for use by the institute itself but also for appropriate use by the public, mainly by high level researchers and visiting scholars who have the knowledge but who lack instruments and equipment. In this way, we can exchange academic thought, broaden our view, and we can develop the function of the instruments and equipment very well. An Australian scientific worker took the initiative to request coming to our Fujian Materials Structure Institute to work for a period because he lacked experimental equipment. He realized achievements in his work. For this, he was very grateful to us and we also learned some things from him.

An important task in strengthening academic leadership is to establish a correct policy for scientific development. Otherwise, "selecting the important" and "selecting the superior" cannot be done well. Of course, an overall policy for science may not be drawn up in 1 or 2 years, but building institutes according to academic disciplines should be supported. The key academic disciplines that have been determined and supported should consider two aspects. One is the trend of development of science in the world, and the other is the need of the nation. We should take the needs of the state as urgent tasks. We should center our efforts on the academic department and invite scientists to draw up a policy to develop science. We must start from the vertical (each system of the academic department) and the horizontal (each type kind of committee). We must develop the function of each academic department and we must pay attention to developing the function of utilitarian bureaus and special committees of the academic department of the academy. We must strive to draw up a general profile of the policy to develop science during the first half of this year. With a policy to develop science, it would be easier to determine the projects and academic disciplines to be supported in a key way. In the future, a guide on special project funding and capital funding within the academy should be printed first, otherwise, funding could not be controlled.

Inflated administrative agencies and rigid bureaucracy are a major hindrance to strengthening academic leadership. The Chinese Communist Party Central Committee and the State Council have already made a strong determination to reorganize and streamline state agencies. Our scientific research units should also do the same. The agencies at the two levels of the academy and the institute should also be readjusted, reorganized and streamlined. And a responsibility system of the work post should be established at each level to strengthen lateral relationships, improve work efficiency and adapt to the needs in strengthening academic leadership.

How can we measure the level of academic leadership of a unit? I believe we should mainly use the academic level and the academic ideology to measure it. A unit with a high academic leadership level has a high academic level and the subjects selected are also accurate and good. Another standard to measure the level of academic leadership is academic ideology, the academic tradition and

the academic atmosphere. The units with a high level of academic leadership not only have an active academic ideology, a good academic tradition, they also have a productive academic atmosphere. We should recognize that these are the important environments and conditions to produce results and talent. Facts are exactly so. Some of our research institutes can produce more results and good results, more talent and good talent because one important aspect is that the academic tradition here is good, the atmosphere is productive, their views are broad, their thoughts are sharp, they can grasp scientific problems accurately and in time for in-depth research. Professor Kenichi Fukui of the Engineering College of Kyoto University in Japan, who received the Nobel Prize for chemistry in 1981, conducted a lot of research in the theory of quantum chemistry in other aspects of work. But this time, he received the Nobel Prize for his major achievement in studying leading molecular orbits. He possesses a very strong thinking ability. His academic thought is very active. He possesses relatively broad knowledge in all aspects and this was the important condition to the realization of his achievements.

II. The Problem of Training Talent

The problem of training talent is a fundamental problem and a strategic problem. Without superior talent, we cannot produce major achievements. Without superior talent, the scientific academy would not become the "nation's team" and it would not be the center of comprehensive research and the highest academic agency. Because of this, the training of talent must be tightly and forcefully grasped. The main strength on the frontline of scientific research at our academy at present basically consists of middle-aged and young scientific workers. They are our hope. I say this not to degrade our scientists of the older generation, in fact, our older scientists have made many contributions to the development of our nation's science. I am talking about the present situation. At present, we must hasten the training of middle-aged and young scientific workers, on the one hand, and, on the other hand, we must train a group with superior talent, or shall we say, talent with a bright future for training, continuously to supplement our academy's scientific research team.

The training of talent requires the skill of "judging horses," an eye for selecting the long distance runners. In the past, when adjusting salaries, giving promotions and evaluating technical skills and jobs, we frequently paid attention only to people "with discoveries, inventions and outstanding contributions" (i.e., people who have made discoveries, inventions and outstanding contributions). These people should be given emphasis, but I believe this is not enough. Those people who have worked with dedication for many decades, who have worked hard, who have occupied and opened up an academic realm and who have continued to make achievements should also be similarly emphasized. We should say, these two kinds of people are both the "long distance runners" needed to develop science. The Nobel Prize is sometimes awarded to people who have made major discoveries during the current year or in recent years, but sometimes it is also awarded to people who have conducted dedicated research in a certain subject for several decades and who have opened up an important academic area and realized major achievements.

In recent years, every sector has paid a lot of attention to selecting progressive elements. This is correct. Progressive elements who have made outstanding achievements early in life should be discovered in time. Their training should be strengthened so that they can become the central vanguard in scientific work. I want to point out emphatically that we should never neglect those "late achievers." In fact, in the history of the world, there are many "late achievers." Einstein who is well known to everyone is such a case. He did not get good grades in elementary school and middle school. He did not qualify for the university the first year after he graduated from middle school. But, later, he realized great achievements known throughout the world. People who show bright promise at an early age and "late achievers" are two different types of people who differ in the time of realizing achievements. In between do they not have anything in common? Of course not. Their common point is that they possess a profound insight, they are very sensitive to new things, the questions they pose have a profound depth. I believe this should be an important reference in selecting superior talent. The talent we need should be "all-round talent." But this is very difficult, therefore we need even more "special talent." In actual life, it is very difficult to require a person to be expert in everything. I believe that the most important aspect in training talent is to enable him to persist in one direction in his job so that he can work steadily without changing direction easily. At the same time, we must enable them to come into contact with work of some other aspects as much as possible, this includes theoretical research and also experimental sciences. When we establish this foundation firmly and broaden knowledge, our views will be broadened, and we will be able to realize major achievements.

The Chinese women's volleyball team is the champion of the world. This has strengthened our confidence in training a "national team" in science and technology. One important condition that enabled the women's volleyball team to become the world's champion was the selection of talent at each level. The best talent was selected for the team and the members were given strict training. We should do the same in training a "national team" in science and technology. For this, the higher educational institutions should continuously supply superior talent to our academy. The second is that we must establish several academic centers and training centers by ourselves. The third is that we must strengthen foreign and domestic academic exchange, enliven thoughts and develop "heterosis." In addition, we should be like the women's volleyball team. The team must be complete. There must be forward and defensive positions. This means, the talent of each profession must be in appropriate proportion. There must not be a lack of necessary organizational and administrative personnel and administrative support personnel. And they also must be in appropriate proportions.

The source of replenishment of scientific researchers of our academy in the future should mainly be graduate students. Therefore, the training of graduate students must be greatly strengthened. Now, some graduate students have an overly limited range of knowledge. They have become too expert in one subject and they can only carry out a very narrow aspect of work. They will not be able to adapt when the work is slightly changed. Such graduate students will not have a bright future for development. For this, we can consider establishing an academic center in areas where there are more research institutes, and

a training base to carry out overall training of graduate students. At present, I see that this can be done at least in Beijing and Shanghai. At the same time, we can also consider joint training of graduate students with higher educational institutions, invite higher educational institutions to conduct basic training and research institutes to conduct specialized training so that graduate students can receive training in both the fundamentals and in specialization. Our specific research personnel and teachers of higher educational institutions can serve concurrently and they can support one another in developing the function of instruments and equipment. Our Fujian Materials Structure Institute has joined the Fuzhou University during these past years to train graduates in structural chemistry. Not long ago, I returned to the institute to hold a thesis question and answer session. I discovered that the caliber of these graduate students were not bad. In general, in the question of training students, I hope that everyone will think about it more and think of more ways.

There is another problem in sending students abroad for training. We should say that this is also a way to train talent. But, first, we must strengthen planning. Second, when we send people abroad, we must consider the working conditions after they return. The year before last when I visited West Germany, I saw the scientific research personnel sent to Professor Ding Zhaozhong [0002 5128 0022] by our academy. They told me that there they were engaged in the most advanced areas, but on their return there would be no equipment in that field and they could only go back to their own work of the past. Such studies abroad thus lose their meaning. Blindly sending people out cannot easily produce high caliber talent. We must consider when we send people away to study their working conditions after they return. Otherwise, even if they acquire advanced knowledge abroad, after their return, they cannot develop what they have learned.

Mobility of personnel is also an important question in training talent. A pool of dead water is very detrimental to scientific research work. Some people enter the research institutes immediately after graduation from the university. They do not even realize any achievements until they become old. In this way, an institute cannot take in that many people. In the United States, after a researcher works at a certain outfit for several years, he will change location. Professors also do the same thing. In this way, both the institutes and the individual can continue to acquire new vitality. Some comrades proposed that scientific research personnel can be reassigned. I feel this is a new idea that can be studied in detail. Generally speaking, we must think of many ways to move personnel about and to enliven the situation.

III. Develop Our Academy's Superiority and Solve the Problem of Cooperative Studies Well

What is the superiority of our academy? Some people say it is multi-disciplinary and varied. This is correct but not complete. This is because in view of the entire educational system of the Ministry of Education, the higher educational institutes have more disciplines than we have. But, in studying new areas, new technology, new materials and new technological processes, our science academy is more complete in talent and equipment. It can organize forces to carry out new tasks and new comprehensive research projects at anytime. This is our true superiority, we must correctly recognize it. We must give more consideration to the state to better develop our superiority.

The trend in scientific and technological development is toward a stronger comprehensiveness. For this, we need cooperation among multiple disciplines and the coordination of various disciplines. For example, the energy problem cannot be solved by one academic discipline. There must be cooperation between the various fields whether in basic research, in applications research or in developmental research work. These are all areas where our academy can develop its superiority. We have the strength to develop our academy's superiority. We must therefore, to develop our academy's superiority and to shoulder the major tasks of the national economy. Of course, we must first select the topics of research well and then consider the problems of organization and coordination. The successful synthesis of these two in our academy was realized during the latter part of November of last year. This project was organized in 1968. After readjustment, 6 units cooperated firstly to carry out the project over a course of 13 years. These have been 13 victorious years and at the same time 13 years filled with conflicts. The work was not smooth. The third Plenary Session of the 11th Party Congress created a politically stable and united environment. We cannot see only the scientific side and forget about the political side. Ideological work must be considered. It is an important aspect that cannot be neglected in carrying out cooperative efforts well.

We must first approve a large number of projects to be carried out and then we must divide the large projects into a series of small problems. We see that when foreign nations develop the atomic bomb and space technology and such new technologies, they always divide the major subjects into a series of small topics. These small topics include basic research, applied research and development research. For this, we must organize a series of units to carry them out and to complete them within a time limit. For one unit to carry out all these subjects is not possible. If large subjects are not divided into small subjects, and if they are not required to be completed within a time limit, then we could not consider scientific management. The use of computers to realize scientific management does not itself have the capability to divide the subjects. We still must rely on the human brain. Scientific workers can develop their function here. Only by dividing them into small subjects and setting a time limit for their completion can we use the computer in management. It is not possible to carry out one large project smoothly and realize major achievements at once. Some small achievements in some small subjects have to be made and accumulated to make major achievements. Only in this way can they have important academic meaning in science or important practical meaning in application. Otherwise, as small subjects alone, they cannot have such a great impetus. The academy of sciences has some experience but the experience is not much. We must develop several projects and consider them well. For example, in energy, we can do a lot of work on conservation, improve the rate of utilization of energy resources, develop energy resources, and mine and utilize coal and petroleum. In determining the projects, we must take into consideration the need of the state and our superiority. How do we analyze a subject? How do we combine a series of small achievements? This is a new realm that must be learned by scientific workers. It is also a new technique in leadership. Without acquiring such experience, our progress will be limited. It is hoped that some research institutes will first invest some efforts to acquire experience. The subjects should be divided into small subjects, and they should be studied separately. When work progresses for a certain period, developmental work must

catch up. Some comrades have proposed a preliminary suggestion in the study of new materials and material sciences. In their suggestion, they analyzed the subjects. For example, in studying the new materials for use as energy resources, there is a subject concerned with "new materials to improve thermal-mechanical efficiency." The research subject is: inorganic high temperature structural materials, nitrides, carbides, toughening oxides, composite materials, metallic high temperature structural materials. The goal is to use them for long periods under temperatures of 1,200 to over 1,400°C. This not only conserves energy, it also creates new resources. For this, we must study the basic scientific problem of screening materials. What is basic research? The United Nations has a unified standard of classification based on the goal of research work. For example, research that does not have a clear goal is called basic research. Research that has a clear goal is called applied research. Broadening the definition further, there must be developmental work before use. For example, the study of differential equations is not necessarily all basic research. We must see what is being studied. The qualitative theory of differential equations does not have a determined goal and it is basic research. The study of Maxwell's equations in electromagnetic wave theory has a clear goal and is applied research. To understand certain classes of differential equations to compile a computer program is developmental work. We still think in terms of the old classification: basic research, applied basic research, applied research,.... To avoid confusion, I still label them basic research, applied research and developmental work according to the method and means of research. The selection of materials cannot be regarded as basic research, but it undoubtedly includes many more basic research subjects. Such subjects should still be studied by research institutes. Also, for example, another small subject is research in preparation technology. It is not simple to produce highly efficient and low-cost powders. We cannot always use old ways, there must be new methods. There is also a lot of basic research that must be carried out first in dealing with phase relationships and phase balance, and in high temperature static pressure processing of powders and we must organize for it. In addition, here are also many good projects that are worth considering in energy, for example, comprehensive research in the use of coal to produce methanol and the utilization of this technique, the study of comprehensive agricultural and forestry energy resources, the comprehensive study of joint circulation of gas, coal, oil and steam to generate electricity.

Comrade Zeng Chenggui [1982 0701 1145] is an oceanographer. He has realized mass production of oceanic life in farms to produce kelp. Now, the production of kelp in our nation is the highest in the world. This is inseparable from the research work carried out by Comrade Zeng Chenggui. He did a lot of work and he regarded the coastal seas as farms. Actually besides kelp, they have also achieved a lot in raising mussels, laver, prawns. Old man Zeng has an even greater ambition to build pastures for aquatic production and to "herd" in larger oceans. These projects are all good. We have realized great and positive achievements in dividing large projects into small subjects and organizing small achievements into large achievements.

In the present national situation, how should we carry out our scientific research work? Not long ago, Comrade Hu Yaobang told me, scientific workers should delve deeply into three realities to grasp their tasks: One is the

reality of scientific theory. This is the situation in the development and the trend in the realm of science. The second is the reality of modernized production. This is the outlook in the production process and modernization. The third is the reality of nature. This is the natural environment and resources. I believe these three points are well noted and they are very important. We should take the initiative to seek out the tasks in the reality of building the four modernizations and use these as the starting points in our scientific research work.

Every research institute should have its own characteristics and superiorities, and it is very important to form such characteristics and superiorities. It is not possible to include everything. We must consider maintaining stability in the direction of our own work over a long period, and we should consider improving the standards and the quality. Only in this way can we benefit the accumulation of knowledge and the greater improvement of the standards. But maintaining stability is not equal to holding on to one thing without letting go. Sometimes, to adapt to the requirements of the state, we must also change from one research subject to another research subject. The stable direction in metaphysics is not right. Carrying out some work in the new realms may be greatly beneficial to future research.

I am willing to remind everyone once again: At the fourth meeting of the Fifth National People's Congress, Premier Zhou made the following comment concerning the basic policy to develop science and technology: "Our basic policy to develop science and technology is clear. There are many branches of science and technology. They should serve every sector. Basic research branches of science and technology. They should serve every sector. Basic research must never be weakened, but the key in the development of the entire realm of science and technology should be to serve economic buildup, and in particular, to serve in solving the key problems that can realize major economic gains in the national economy. The current task is to better develop the function of science and technology so that they can truly become a strong and productive force and a great force in promoting economic development."

Our scientific academy has its characteristics and superiorities. We must correctly recognize our superiorities and better develop our superiorities to make greater and better contributions to the nation and to science!

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NATIONAL DEVELOPMENTS

PERSONNEL REQUIREMENTS FOR MODERNIZED MANAGEMENT STUDIED

Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 3, July 82
pp 7-12

[Article by Guan Xipu [7070 6007 2528] and He Zhongxiu [0149 6945 4423] of the Tianjin Science and Technology Management Magazine: "On Modern Scientific Management and Its Requirements for Management Personnel"]

[Text] The buildup of modernization needs modernized management. Modern scientific management has been regarded by people as a new element in the composition of modern social productivity. It is an indispensable pillar in the buildup of modernization. Over the past several decades, especially after World War II, foreign management scholars have published many papers on modern scientific management. Many of them are worth understanding. But the theoretical viewpoints are sometimes not scientific enough, and not all management methods proposed are generalized. To improve the standard of management personnel at all levels in our nation, we must learn and refer to foreign experience, and at the same time we must do the fundamental work well by combining the principles of Marxism, the principles of socialism and our nation's actual situation. This article is an attempt to explore the actual content, main principles, basic methods of modern scientific management and the logical relations among the three, and the requirements they place upon managers, and such questions concerning fundamental management ideas.

I. The Actual Content of Modern Scientific Management

Correctly recognizing the actual content of modern scientific management is a prerequisite to determine management principles correctly and to select the method of management. When domestic and foreign management scholars talk about scientific management by citing the objects of management, the management process, the goals of management and the characteristics of modern management, they have touched upon this question to varying degrees. But their understanding has been rather unilateral or has not been clear enough. We still need to provide a scientific answer based on the actual situation in modern management work and by using related principles of Marxism.

Combining theory and practice, analyzing the object, process and goals of modern management in detail and generalizing the common nature provide us with

the following understanding: The most fundamental aspect of modern scientific management is the optimum control of the process of uniform motion of systems, people, values. Systems are the objectives of management. People are the objects and the motive force of management, and increasing value is the goal of management. "People" who carry out concurrent tasks of effectively controlling the unified and coordinated motion of the object, the motive force and the goal to realize the actual substance of modern scientific management are the core of this course of uniform motion.

(1) The Elements of the Objects of Management

Earlier management theory believed that the three main elements were people, money and materials. Later, some people added information and time to make it the five major elements.

Recently, some people added esprit de corps and method to make it the seven major elements. The continuing increase in the object elements reflects the new development in the objects of management and shows that management is becoming more complex, and it also reflects the elevation of the standards of modern management science. This is undoubtedly a good phenomenon. But, these understandings and expressions all show shortcomings of being isolated, disconnected, mechanically arranged, biased. They have not been able to further demonstrate the organic relationship between the various elements of the objects of management.

If we link all the elements together and consider them as a whole, we will discover that the object of management is not the mechanical addition of isolated elements, but a unification of the whole, the part, mutual relationships, and variations and conversions of relationships. What is this object that unifies the whole and the part, mutual relationships, variations and conversions of relations? It is the system! It is the "dynamic system" that is recognized by modern science! This is to advance the metaphysical understanding of management to a dialectic understanding, from a static understanding to a dynamic understanding, from an understanding mainly of the actual material to an understanding of the variation and conversion of mutual relationships at the same time. Such an understanding of the object of management is a development in understanding and at the same time it coincides more with the actual situation in development. If modern management workers cannot dialectically and comprehensively grasp the object of management, it will be difficult for them to meet the requirements of modern scientific management.

(2) The Core or Motive Force of Management

There are different views from different angles. People often compare the different elements of the object of management to the different links in the course of management (determining the goals, drawing up plans, organizing forces, commanding action, adjusting relationships, controlling systems). They believe that the element or link that is the most important and that can influence the overall situation the most should be regarded as the core or motive force of management. This method of comparison is right. But because people's viewpoints are different, different conclusions are drawn. For example, many management scholars in capitalist nations believe money is the core of management and also the motive force in management. Of course, it is the goal of management. There are others who believe the core or motive force of management should be "the flow of information." Henry H. Albers, author of "Principles of Management: A Modern Approach" emphasizes information and decision-

making. There are also different views on this question. Some emphasize decisionmaking, some emphasize planning, and some emphasize goals. Each has his own views. The representative of modern Western management science, 1978 Nobel prize winner in economics, H. A. Simon, believes that the entire management process is a decisionmaking process, obviously he also emphasizes decision-making.

We believe that when we use the method of comparison to analyze and understand the core or motive force in management, we must be guided by the scientific viewpoints of Marxism. The result of doing so enables us to come to the following conclusion: The core or motive force of modern scientific management should be people! This does not relegate the importance of information, decision-making, goals, planning, etc, but it truthfully proves that regardless of whether it is from the viewpoint of the whole or part of the object of management, or whether it is from the viewpoint of each of the links in the management process, management works and serves its function only through man's action. This is consistent with the principles of historical dialectics. Management work is a social behavior. The main body of society is man. All social activities are human activities. Therefore only man can be the true core and motive force in management work. If management workers in a socialist nation cannot correctly recognize and firmly grasp this core and motive force, it is very difficult to carry out modern scientific management work well.

(3) The Goals of Scientific Management

Scholars of capitalist nations generally describe the goal of scientific management as improving labor and work efficiency. Of course some people have described it more theoretically saying that it is the unification of the functions of the parts of the object of management and the amplification of the whole so that the function of the whole is larger than the additive sum of each of its parts. Many comrades in our nation accept this theory. We also believe this theory indeed has its reasons. But this expression which seems to be free from disagreement does not expose the final goal of management work. Obviously, the real purpose of improving efficiency in capitalism is only to increase the profits for the capitalist class. Although socialist nations must also consider profits, but increasing profits must never be said to be the fundamental purpose of improving management efficiency. According to the principles of Marxism and the principles of socialism, the fundamental purpose of carrying out scientific management and improving labor and work efficiency in a socialist nation is and must necessarily be to increase and improve the value created by the object of management (including the numerical value created by the object of management (including the numerical value and the value rate), and it should be the unification of economic and social values. The unification of economic value and social value must also stipulate that when there is a conflict between economic benefits and social benefits, one should serve social benefits. Because, there are indeed such cases: Certain improvement in management efficiency frequently will be beneficial to realizing short-sighted and partial economic benefits but may not be beneficial to and even may be harmful to social benefits. This, then, is not consistent with the fundamental goals of modern scientific management. For example, uncontrolled felling of forests destroys the ecological balance, increases production and seriously pollutes the environment, etc.

(4) The Actual Substance of Modern Scientific Management Is a Coordinated Process To Stimulate Manpower, Control Systems and Produce Value

Correctly recognizing this actual substance helps one deepen one's understanding of the following characteristics of modern scientific management: (1) It is not just the organic combination of managing the whole and the parts, it is an organic combination of dynamic management and static management, i.e., the parts must serve the whole. The relationships between the objects of management, the movement, variation and conversion of the relationships must be emphasized. Effective information feedback circuits within the system must always be maintained and the versatile flow of information and feedback that should exist between one's own system and other related systems must be maintained. (2) It is an organic combination of "managing" people and "managing" materials, and it should mainly be "managing" people, i.e., management of other aspects must be led by mobilizing the enthusiasm and creativity of people. (3) It is the organic combination of economic goals and social goals while the social goals are the main goals, i.e., economic goals must also serve social goals. Grasping these characteristics of modern scientific management will greatly benefit us in overcoming those mechanical, dull and slow ways of thinking and methods in management work.

We believe that the above points should be the basic understanding of modern scientific management that one should possess. On the basis of this fundamental understanding, it would be easier to explore what major principles should be upheld and what basic methods should be pursued in modern scientific management.

II. The Main Principles of Basic Methods of Modern Scientific Management

(1) The Principle of Management Is Determined By the Actual Substance of Management

The actual substance of modern scientific management is the unified action of the three main elements, the system, people and value. Correspondingly, there are also three major principles in modern scientific management, i.e., the systems principle, the "humanistic" principle and the value principle.

The systems principle in scientific management requires management workers to realize that the object of one's management effort is a whole system, therefore the parts should be treated with a view of the whole and the parts should concretely serve the whole. At the same time, they must also truthfully admit that the whole as managed by oneself is only a component of a larger system, therefore they must also consider the larger whole and place one's own management system in the right position so that it can serve the benefit of the whole of the large system. In our insistence on the systems principle we must oppose and prevent separation, isolation, one-sidedness, seeing the trees without seeing the forests in considering and carrying out various management tasks. Management that violates the systems principle will never become true scientific management.

The "humanistic" principle in scientific management requires management workers to regard the adjustment, control and management of human behavior as the center and the key in managing the entire system well, to regard the mobilization of the enthusiasm and creativity of people as the fundamental factors in carrying out the entire management task well, to concretely believe that in order to manage money, materials, information and time and such elements well, one must first develop man's enthusiasm before this can be achieved. In insisting on this "humanistic" principle we must oppose and prevent the mistaken concept of considering materials but not people, and the belief that "things can be done when there is money." Management that violates this "humanistic" principle similarly is not true scientific management.

The value principle in scientific management requires management workers to always remember that the fundamental goal of management is to create value for society in the best way. Management can create social value. Management that cannot create economic value and social value in the best way is ineffective management and it is a dereliction of management's duty. Even when one is very busy, he is still an ineffective manager who has neglected his duty. In insisting on the value principle we must oppose and prevent the so-called "leaders in principle" who only talk about "motives" but not results, and we must oppose and prevent the routinism of being busy in blind pursuits. We must oppose and prevent the style of being a spendthrift. Management that violates this value principle, no matter how, will not be true scientific management.

(2) Correspondingly, Modern Scientific Management Has Three Basic Methods That Are Commonly Suitable for Use, i.e., the Systematic Method, the Behavioral Method and the Value Method

The systematic method is the scientific method that extends the objective laws of systems of things to the rules of thought to handle things and solve problems. It is closely related to systems theory and systems engineering, but it is not entirely the same. Systems theory is the theoretical science that studies the structure, system, stratification and laws of motion of objective things. Systems engineering is the quantitative, programmed, technical application of systematic methods in various types of engineering projects, and it is an engineering technique. Every manager must have some knowledge about systems theory and systems engineering, but he does not have to be directly involved in quantitative calculations and technical operations. This is because the manager is actually the organizer and the "leader" (not necessarily having a positional title as a leader) at various different functional levels. Therefore, more important is that he must skillfully grasp the systematic method. In doing management work well, the main points of the systematic method is generally a unified process consisting of the following links: 1. viewing the overall system (the whole); 2. resolving the structure (part); 3. recognizing the relationships; 4. separating the strata; 5. tracing changes; 6. adjusting feedback; 7. controlling the direction; 8. realizing the goal. These important points cannot be separated and they must be uniformly utilized. There is a red line running through and connecting these points. It is the recognition, the adjustment and control of the various relationships in the system. This is the most fundamental method of thinking and working of the modern scientific management worker. To the people accustomed to the method of management of

small production and handicraft industries, this method is complicated and variable and it seems to be difficult to grasp. But as long as this point is constantly kept in mind, continuously studied self-consciously, and used, the systematic method is not difficult to grasp.

The behavioral method corresponds to the "humanistic" principle of management. Because mobilizing the enthusiasm of personnel at each level and of all types of people is the basis for doing management work well, therefore, how to scientifically manage the behavior of subordinates is a key problem. The behavioral method is a method to conduct scientific analysis of the behaviors of various types of personnel and a method of effective management of one's own subjects of management. At present, most of the books on behavioral management we have seen are foreign publications or books that introduce foreign methods. They mainly study the following. First, they study ways to control behavioral motives by analyzing human "needs." Second, they study ways to explore the principles of behavioral management and the methods that can possibly be used. In the Marxist viewpoint, this type of study starts out from experimental psychology to analyze the different objective needs of various types of personnel, study the different motives that produce the various behaviors to satisfy different needs, and propose the use of various psychological laws and corresponding methods to manage the behavior of different types of personnel. It is believed that the purpose of the method of behavioral management is to stimulate the enthusiasm of the various types of personnel...these indeed have a scientific basis. They have proposed many methods based on this and have objectively realized a lot of results. We should not negate them lightly. But, it seems that those theories are filled with the abstract theory of human nature, poisonous supra-class dogmatism and capitalist individualism and utilitarianism. Also, they emphasize the study of behavioral psychology of the individual and its method of management and seldom study the behavioral psychology of the collective and the society and its method of management. Some people even study "collective behavior," but the study is only limited to small collectives and starts out from the opposing viewpoint of "how to control" them. For this, we must utilize the position, viewpoint and method of Marxism to carry out objective analysis, to take the rational inner core and to discard the outer shell, to create, develop and establish our own behavioral management science.

In fact, we have a lot of successful practical experience in our own behavioral management method, but we have not systematically and theoretically summarized such experience. The task of theoretically summarizing such experience by borrowing the active elements in foreign behavioral management studies, basing such experience on our own ideological and political work and the experience of democratic business management and combining the experience with the actual situation in our nation's buildup has already been included in the daily agenda and the responsibility has fallen on our shoulders. In our socialist nation, the fundamental purpose of using behavioral methods in scientific management is to mobilize, consolidate and develop the socialist enthusiasm of the people to the maximum extent. To realize this goal, we believe, there are at least the following three "guidelines" that must be emphasized:

(1) We Must Satisfy the Proper, Rational Objective Material and Spiritual Needs of Our Own Subordinates. Everyone of us who are dialectic materialists should recognize that everyone has his own objective needs. Managers should exert all

efforts to solve all rational and possible material and spiritual needs. This is the fundamental prerequisite in mobilizing the people's socialist labor enthusiasm, and it is also the fundamental goal in carrying out socialist revolution and buildup. In a socialist nation, the following four "needs" should be the proper, rational and most basic objective material and spiritual needs for the whole people, i.e., truly receiving more for more work and not just in name only; respecting the honor of being the master of the nation; comradeship and organizational warmth; encouraging aggressive revolutionary behavior. Only by satisfying these needs, can we truly mobilize and stimulate their enthusiasm, initiative and creativity. Here we emphasize "truly," i.e., we must have practical and reliable measures, not ordinary campaigns. For this, we must concretely oppose and conscientiously overcome the following in management work: the egalitarianism that doing more and doing less are the same and that doing well and doing poorly are the same; the lofty bureaucratism and special showing that is seriously detached from the masses; such extreme leftist ideological waves of putting labels on others, coming down with the big stick, capitalizing on others, exaggeration and the narrow and jealous mentality of not being able to accept other people for "being outstanding." Otherwise, the managers and those being managed will not have the same heart and mind, and everyone's self-conscious enthusiasm cannot be mobilized. Without people's self-conscious enthusiasm, the smooth development of socialist endeavors are difficult to imagine. This is a major problem of principle, and every manager must not treat this lightly.

(2) Everyone Must Have Concrete Duties That Are Fixed and That Can Be Evaluated. According to different situations, implementing a rational post responsibility system is the key to doing modern scientific management work well. Every productive enterprise, business enterprise and business must implement a responsibility system that suits its own situation, and every responsibility must finally be implemented down to the individual. This is a fundamental requirement of the production responsibility system were implemented broadly in our nation's farm villages, agriculture quickly progressed. Our nation's industrial enterprises are also testing and exploring the experience of implementing the economic responsibility system. When it is effectively implemented, industry will also quickly progress. In scientific and technological endeavors, although the situation is more special and complicated, the responsibility system is still the requirement of objective laws, and it must be implemented. Of course, the actual method of implementation still needs to be actively and carefully explored and summarized by everyone in practice.

(3) Everyone's Responsibility Must Be Conscientiously "Inspected." This means, the efficiency and results of everyone's work must be strictly and conscientiously and clearly examined and evaluated, and the person should receive appropriate awards or punishment according to regulations. This is an important link in the use of the behavioral management method in scientific management. Without this link, we will not be able to implement the "needs" and "duties" described above. Whether a person's work is truly good or bad can only be judged by the actual results at the end. Although good motives are important, but it must be unified with good results. Working hard and not being upset by criticism is a good spirit, but being busy everyday does not necessarily mean doing more good work. A good manager should not watch over his subordinates every minute to see "how they work," causing the subordinates to be extremely careful and timid.

He should inspect their final "work output." This is an important behavioral management method. Only this method can truly stimulate people's sense of responsibility, initiative and creativity in work.

We have a lot of practical experience to prove that in the course of management, if we grasp tightly these three guidelines of the behavioral management method to solidify and develop everyone's socialist enthusiasm, then doing management work well can be guaranteed 80 to 90 percent.

The value method is the ideological and working method to realize value engineering. The formula for value engineering is

$$\text{Value V (Value)} = \frac{\text{Function F (Function)}}{\text{Cost C (Cost)}}$$

It tells us that to increase the value, one method is to improve function or reduce cost. The other method is to improve function and reduce cost. Of course the latter is the best method. When we regard it as an ideological and working method in scientific management, we can call it the large, high and low "goal management method," i.e., large value, high efficiency and low cost management method. At present, the so-called "goal oriented management" popular abroad actually manifests a certain aspect of this type of value management method. We can use the value principle of socialism to generalize it, thus the value management method of modern scientific management should have the following three main points: One is that when a manager engages in management work, he must always keep in mind the fundamental purpose of modern scientific management, i.e., to make one's own management beneficial to creating greater economic and social value. The second is that in order to realize the fundamental goal above, the manager should continue to implement measures and to think of all ways to "reduce cost" (including the conservation of manpower, energy, resources and raw materials, etc) and "improve efficiency" (including mobilizing the people's enthusiasm and improving work efficiency, etc). The third is that he must concretely achieve the fundamental goal that is to be reached and the concrete measures that should be implemented in all of his own management objects (people, money, information, time etc).

III. The Accomplishments Required of Managers in Modern Scientific Management

According to the actual content, main principles and basic methods of modern scientific management, it is not difficult to see that the following accomplishments are required of managers:

1. He should "have a broad knowledge and be multitalented." Because modern scientific management is a systematic whole that utilizes the systems principle and systematic methods to manage specific objects, therefore a management worker must possess the various kinds of fundamental knowledge related to this systematic whole. The knowledge frequently involves natural sciences, economics, other social sciences and social knowledge. Modern management as a science requires the manager to truly become a management specialist. This type of specialist must have a broad knowledge and possess many talents. Otherwise, it would be difficult for him skillfully to carry out complex systems management.

2. He should be "resourceful and good at making decisions." Because systems management is a kind of "dynamic" and "live" management, this type of "dynamic" and "live" management requires "random feedback" and "making decisions on the spot" involving a massive amount of related "information flow," and it requires making decisions and handling the work on time. This requires the modern scientific management worker to be resourceful and decisive like an "information processor" with a large throughput capacity. He should draw on collective wisdom and absorb all useful ideas, he should react sensitively, he should be accustomed to thinking, his decisions should be decisive, he should be an intense mental laborer. A person who is ignorant and ill-informed, who has a slow reaction, who is opinionated and who is indecisive can hardly become a good modern scientific manager.

3. He should "be good at dealing with people." Because the core of the "humanistic" principle and the behavioral method of management systems is people, then, as a management worker, he must possess conditions of "being good at dealing with people." First, he should practice the "four skills": the skill of knowing people, the skill of being close to people, the skill of being able to use people, and the skill of helping people. On this basis, he must also realize the "five abilities" at the same time: the ability to make people listen, to make people trust him, to make people obey him, to make people respect him and to make people help him. Only in this way can he win over others. This requires our management workers to be just and fair, to know people and to be skilled in employing people, to be understanding, to treat everyone equally, and to be able to cooperate with everyone. If he is bureaucratic, if he has a haughty manner, if he is cold toward people, if he tyrannically abuses his power, if he forces commands upon others, if he abuses his authority or "rather offends others but others are not allowed to offend him," then he will surely "lose his people." People who "lose people" cannot do management work well.

4. He should "be strict and clear in giving awards and punishment." Because modern management workers must utilize the value principle and the value method to realize the fundamental goal of management--creating the best economic value and social value, and because the behavioral management method requires insisting on the principle of "responsibility" and "inspection," management workers must be a "fair judge" and insist on using the "value result" to determine the achievements and faults of subordinates in their work, rewarding those deserving rewards, punishing those deserving punishment, rewarding and punishing clearly, being impartial and incorruptible. Modern scientific management workers are not allowed to be "indiscriminate officials" who are "not troubled by oligarchy" nor "troubled by egalitarianism," who "award 40 ounces of gold" to those who have done well and who "gives 40 lashes" to those who have erred. "Indiscriminate officials" cannot do modern management work well.

These requirements and conditions include political ideology, the style of work, scientific knowledge and practical experience, and to possess them fully is very difficult. Because of this, modern management work should be emphasized and respected even more. Management workers are honorable. The view that scientific management work is just pushing administrative work and that scientific management workers are not as important as specialized scientific and technical workers is obviously wrong.

We can borrow Einstein's equation of mass and energy $E=MC^2$ as the best model for the modern scientific management worker. The formula shows that the energy of matter is directly proportional to the product of the mass M of matter and the fastest velocity of motion (the speed of light) C^2 , i.e., the larger the mass, the higher the velocity, the larger the energy. Now, let us use E to represent the efficiency of management, M to represent the accomplishment of the manager, and C to represent the fastest speed of management work, then we obtain the following best model for the modern scientific manager:

Management efficiency E = manager's accomplishment M x work speed C^2 .

In the model, "accomplishment" is a comprehensive concept. It includes thought, knowledge, quality, work style and such required conditions. According to this best model, modern scientific management workers are required to continually improve their own accomplishment, seize time and speed in work to realize the greatest management efficiency.

It is hoped that our management workers can all correctly understand the actual content, the main principles and the basic methods of modern scientific management, propose various requirements according to the above, continue to improve one's own accomplishment, and contribute more to the buildup of modernization of the socialist motherland in management work.

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NATIONAL DEVELOPMENT

RESEARCH INSTITUTE NOTES MUCH WORK REMAINS TO SATISFY DEMANDS

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[Article by Wu Lingman [1566 1694 3341] and Jin Xiaoyin [6855 1321 6892] of the Shanghai Silicates Research Institute of the Chinese Academy of Sciences: "Serving Local Economic Buildup by Combining Our Institute's Characteristics"]

[Text] Our institute is a material sciences research institute subordinate to the Chinese Academy of Sciences. We mainly study artificial monocrystals, special purpose glass, porcelains used in electronics, high temperature structural porcelains and inorganic paints. The study of these new types of inorganic materials is closely related to the economic buildup of Shanghai. We have combined the academic direction and the technical advantages of our institute, fully developed our potential actively to serve local economic buildup. In the following, we will briefly report on some work in serving the locality.

1. We Have Actively Shouldered Local Scientific Research Tasks and Trial Production Tasks

Although we are a research institute of the Chinese Academy of Sciences, the Shanghai City Scientific Committee and various sectors have given us a lot of support and help. The city's conditions for cooperation and support are good. They are favorable to the development of scientific research. These have all encouraged and driven us to exert efforts to complete the scientific research tasks handed down to us by the state and we have also actively shouldered local scientific research tasks. Over the years, by taking the initiative, we have always actively carried out some of the scientific research tasks of the major and comprehensive scientific research projects of Shanghai, such as the 7,112 project, the 728 project, the 708 project, and the optical fiber communications project. We have strived to contribute more to the locality.

Optical fiber communications is a new technology that emerged at the beginning of the 1970's. The city scientific committee organized several dozen units throughout the city to hasten the breakthrough in this major scientific research project to develop modern communications. We actively participated in the Shanghai task force and took the initiative to shoulder the task of studying optical fibers. Because this subject is difficult and strongly comprehensive

and the schedule was tight, we organized interdisciplinary scientific research cooperation centered around the third research laboratory, and we fully utilized favorable conditions within the institute, improved efficiency in scientific research, hastened progress, and in 1977, successfully developed the phosphorous-silicon series quartz optical fiber that has a short wavelength and a low loss and a wide frequency band. Under the leadership and organization of the city scientific committee and the optical fiber office, we established a cooperative relationship in scientific research and production with the Shanghai Xinhua Glass Plant in the 2d year. With mutual alliance, cooperation and mutual respect, we launched a relay competition in technology and smoothly handed over scientific research achievements in phases to the factory for tests and production. The factory spent only 7 months and, for our nation, produced on a trial basis a definite quantity of qualified optical fibers and provided optical fibers for laying the first 1.8-kilometer long optical communications cable in the city of Shanghai. The factory spent only 2 1/2 years to reach the level of volume production and contributed to our nation's optical fiber communications. Last year, we began the second phase study of the phosphorous-germanium-silicon series multiple mode long wavelength optical fiber.

In addition, the difficulties presented by the factory were also solved as much as possible. For example: The electrical resistors manufactured by such units as the Shanghai Electrical Resistors Plant required a type of electrical insulation coating that can resist temperatures of $350\pm 40^\circ\text{C}$. They originally used toxic enamel containing about 50 percent lead. This polluted the environment and seriously affected the health of production workers. At the beginning of last year, the factory presented the subject to us hoping that the coating could be replaced by a nontoxic coating. Comrades of our institute's heat treated paints group actively shouldered the task of quickly solving the problem in production. During the first half of last year, it developed two types of nontoxic coatings. One was the baked PA-6 coating suitable for use on disc-less rheostats. The electrical resistance was greater than 10^{12} ohms and it already met the required specifications. The other was the leadless enamel Rg. Experiments prove that it can replace leaded enamel. After improvements during the second half of the year, it will be able to have even broader uses. Also, for example, in 1980, the Shanghai Boiler Plant presented us with a task to develop a protective paint for surface annealing (650°C) in fine processing of large products. Although the paint originally used by that plant did serve a protective function, after treatment, the coating was difficult to remove. If mechanical methods such as spraying sand were used, the fine processed surface would be destroyed. We exerted unscheduled efforts to develop a type of paint for that plant. After annealing, the coating could be removed with water. This satisfactorily solved the difficulty of that plant in production.

II. Combine the Far and the Near To Contribute to the Development of the Present National Economy

According to the founding guidelines of the Chinese Academy of Sciences and the goals of our institute, we must study and develop materials science and continue to improve the academic standard in research work, and we must also serve the national economy and national defense buildup. Statistics of the research subjects of our institute during recent years show that about 48 percent of the

research subjects are internationally important work and about 10 percent are subjects in basic theory, and 40 percent are developmental research. Some of them are near-term work. The above ratios indicate that basic research in our institute does not constitute a large percentage and this needs gradually to be strengthened. We are creating conditions and actively encouraging those scientific and technical personnel with a firm foundation, higher foreign language capability and who are more interested in theoretical work steadily to develop research in basic theory when the conditions ripen. When arranging long-term exploratory scientific research work, we organized some scientific and technical personnel to conduct social surveys and market surveys, and we lined up some key technical problems that urgently have needed to be solved in the national economy in recent years to combine long-term and the short-term endeavors. For example, the study of noncrystalline semiconductor materials and devices is a relatively difficult and more important problem that is being actively studied internationally. Our institute has already studied this for many years. We have paid attention to the study of physical and chemical processes in the gas phase formation of glass film of noncrystalline semiconductor materials, composition of gas phases and the structural system of the film and basic studies of electron transmission characteristics of photoelectric conducting materials. We also paid attention to the study and development of such materials for short-term applications. The comrades of that group established the short-term goal of applied research in static photocopying through surveys and analysis of the domestic and foreign situation. The copying machine is widely used in foreign nations. The quantity produced is also large. For example, Japan manufactures 680,000 units a year. The annual amount of sales in the international market reaches over \$10 million. Our nation is still relatively behind in this aspect. We produce only over 2,000 units a year. The whole nation only has over 5,000 units. Also, the quality of domestically produced copiers are not stable enough. The drum is the heart of the copier. How to improve the sensitivity and the life of the drum is a key problem in present production. In September 1980, our institute signed a cooperation agreement with the Shanghai Copier Plant jointly to improve the life of the drum. We helped the factory establish the technological flow process line for the synthesis of glass and selected eight kinds of sulfur series glass preparations. We conducted photoelectric conductance tests, differential heat analysis, optical spectrum properties test and hardness tests and such physical performance tests for the film and the test materials, and we conducted chemical composition analysis. We plated a total of 35 drums. The drums operated well. It was generally believed the sensitivity of the new sulphur series noncrystalline drum was higher than the pure drum by one to two times. The useful life was at least 15,000 times and with highs reaching over 45,000 times. The life of the original drum was below 10,000 times. After the film coating techniques are further stabilized, we hope gradually to begin production in the shop within the year.

III. Transfer of Military Scientific Research to Scientific Research for Civilian Applications

During the 1960's and the beginning of the 1970's, many of the tasks of our institute came from the National Defense Science Committee and the National Defense Industry Office system. During the latter part of the 1970's, as the

national economy was readjusted, the number of research subjects in military science gradually reduced, and we transferred such military subjects to civilian use in time. Take the inorganic coating research laboratory as an example. Originally, over 90 percent of the work of that laboratory was involved in the study of new materials needed in national defense and the military industry. After readjustment, at present, over 54 percent of the work is involved in scientific research for civilian use. In the winter of 1974, we began the study of far infrared heating techniques. We used the technical equipment and testing equipment established for military scientific research and this research work progressed relatively quickly. We spent only 3 years to develop and produce successfully the three techniques of coating with paints, electric arc plasma jet spraying and enamel smelting and over 20 types of coats. At the same time, we also successfully developed a far infrared heater, drying equipment and medium temperature normal full radiation testing equipment. The varieties were complete and the applications were broad. These coatings have already been popularized and produced by the Shanghai Changzheng Farm Coating Plant and two plants in Jiangsu Province. With the common efforts of many scientific research units and factories throughout the city, Shanghai now has over 30 professions and about 4,000 units that use this new technique. Each year, they conserve about 200 million kilowatt-hours of electricity.

In addition, the plasma sprayed coating group originally involved mainly in military scientific research has also shifted toward mainly civilian scientific research in recent years. Research in coatings for the probe of molten steel oxygen fixing tests, cathode catalytic coats for electrolysis of caustic soda, coating for artificial joints have realized definite achievements, especially the sprayed chromium oxide heat resistant coating has already been popularized and produced by such units as the machinery repair plant of the General Jinshan Petrochemical Plant in Shanghai. Visible economic results have been obtained. The plant originally had to import from Japan the sealing washers for end-facing machinery for chemical industry pumps. Now, they do not have to be imported. Since 1976 when trial production began, the plant has conserved a cumulative total of over 500,000 yuan. The value of the coating alone described above constituted about one-seventh of the total value.

Based on the requirements proposed by the factories in production, we began studying high strength acid and alkaline resistant enamel last year and we have realized visible achievements. We have test produced it at the Fengbin Joint Factory of the Shanghai Enamel Factory No 1. This type of enamel not only satisfies the technical requirements for industrial enamel in production, its tolerance to acid is 7 to 8 times better than the standards issued by the ministry and the tolerance to alkalines is 2 to 3 times better. After 3 hours of alkaline corrosion, the enamel does not continue to corrode anymore. This type of enamel is more ideal than the industrial enamel-B currently in use. It is a good acid-tolerant and alkaline-tolerant enamel.

IV. Scientific Research Must Also Actively Contribute to the Improvement of the Living Standard of the People

Everyone knows that at present, the diseases that pose the greatest threat to human life and that have the highest death rate are heart disease, cardiovas-

cular diseases and various types of cancer. To protect the people's health and prolong human life, we should mainly engage in preventive medicine and we should think of ways to diagnose early various types of heart diseases, cardiovascular diseases, cancer of the liver, tumors of the stomach. The most effective diagnostic method abroad is the use of ultrasonic imaging technique. Our nation is still backward in this technique. To change rapidly the backwardness in medical diagnosis in our nation, we cooperated with the Sixth Hospital to develop a medical ultrasonic focus single probe and a 64-head ultrasonic broken layer imaging transducer. After over 2 years of exploration, the focusing single probe has reached the standard of the same types of foreign instruments. It is suitable for various types of domestically manufactured cardiograms and B-type ultrasonic imaging machines, and it is also suitable for the cardiographs imported from Japan. This type of probe has already been clinically applied by the Sixth Hospital, the Zhongshan Hospital and the chest hospital and such units. The Changhai Hospital combined the use of the domestically produced ultrasonic imaging machine to diagnose various types of pathological changes in cancer of the liver, the gall bladder, the kidney and stomach tumors. After more than 1 year of application, the results have been good, the performance has been superior, and it has coincided with the requirements of clinical diagnosis. Rapidly to popularize it, and to satisfy the needs of more factories and hospitals, we test produced over 600 units. The Sixth Hospital test manufactured over 500 probes and provided them to the Shanghai Medical Electronics Instrument Plant and the city's hospitals for use. The cooperative research in the 64-head ultrasonic broken layer image transducer also progressed and has approached the stage for practical application.

In addition, we have also provided various types of porcelain components of ultrasonic piezoelectric components to the Donghai Station and the Wuhan Radio Research Institute. And we have popularized this type of piezoelectric porcelain at the Shanghai General Toy Factory to be produced by its first branch factory. After more than 2 years of efforts, it can now be mass produced and it is being supplied to over 30 units throughout the nation for use.

Because the living standard of the people has continued to improve, the need for television sets has become greater. In recent years, we successfully developed the acoustic surface wave filter that can be used on color television sets. The main performance specifications can reach the level of the Toshiba products of Japan. This wave filter has replaced the 6 to 7 medium cycle wave filters in the original circuits. It eliminates complicated testing and it facilitates integration. Last year, it has been popularized at two radio plants in Shanghai and two radio factories elsewhere for production. At present, some factories are studying and readjusting the circuits to prepare for its use on black and white television sets.

According to the requirements presented by the factories, we studied the glass for the black and white television tubes from the beginning of 1976 to the beginning of 1979. With the active cooperation and support of many factories in Shanghai, we quickly completed the study of the S-2 formula for the glass of black and white tubes and its technology. This formula does not contain lithium nor fluoride, it can also conserve expensive lithium carbonate raw materials, and it avoids public pollution by fluoride and poisoning by the

cathode electron gun. In 1979, concerned factories in Shanghai used this formula and technique in production. Annual output reached 500,000 glass cases, and in 1980, this reached over 600,000 glass cases. Comrades of the No 7 Shanghai Electron Tube Plant said, because this scientific research achievement was used, the quality of products and the percentage of qualified products improved. When combined with other related measures, that factory changed losses into profits and at the same time visibly improved the life of the black and white television tube.

Although we have done some work in local economic buildup, we are still far behind in satisfying the demands of social and economic development in Shanghai. We have seldom delved deeply into production on conscientiously sought subjects. The number of projects that have been popularized in production in Shanghai is still small. Analytic and testing techniques still cannot satisfy the requirements of sister units. Scientific research potential is still not fully developed. The efficiency in scientific research is still not high enough. Some research projects take a long time. Technical help and technical consultation for specialized factories producing marketable products are poor. We are determined to conscientiously improve the style of work and to serve local economic buildup better.

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NATIONAL DEVELOPMENTS

REFORM OF RESEARCH INSTITUTE SYSTEM STUDIED

Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 3, July 82
pp 53-55

[Article by Na Baokui [6719 1405 7608] and Jiang Junzhao [3068 0689 3564] of the Main Academy of Steel and Iron Research of the Ministry of Metallurgical Industry: "Preliminary Study of Reforming the System of Research Institutes of the Industrial Sector"]

[Text] Since the founding of the nation, and as the economy and society developed, science and technology development also expanded and a relatively complete research system was established, including the Chinese Academy of Sciences, higher educational institutions, the research institutes and academies of the industrial sector and research units subordinate to the localities and factories and mines. Each has served its function in basic research, applied research and developmental research. They have realized a lot of achievements in scientific research and they have contributed to the development of the national economy and national defense industries.

The reform of the system of research institutes on the scientific research front emphasizes strengthening scientific and technical research by enterprises, reorganizing scientific research agencies and scientific research funds appropriated by the state and related problems, while continuing to expand the autonomy of research institutes at test points. The Chinese Academy of Sciences held its fourth academic department membership conference, clarified the nature, tasks and founding principles of the academy. Driven by the expansion of the autonomy of enterprises, the scientific and technical research work of factories, mines and such enterprises has clarified its direction and has developed more quickly. The research academies and institutes of the industrial sector are facing some actual problems related to readjustment and reform and these problems urgently need to be solved.

The research academies and institutes of the industrial sector mostly belong to the units directly led by the various ministries of the State Council and the commissions. Most of the scientific research tasks come from the higher echelon ministries and commissions or tasks given to the ministries and higher echelon commissions by other departments and handed down. These tasks are mostly scientific and technical problems with a comprehension character. Although most are applied research, basic research and developmental research also constitute

a definite proportion. For example, the projects of our academy are: comprehensive utilization of Baotou and Panzhihua Mines, blast furnace spraying of coal cinder, the new technique of top and bottom blowing of oxygen in a rotary furnace to smelt steel, continuous casting to protect residues and automatic control of electromagnetic mixing and automatic control of the thickness of the plate roller, and controlled rolling in hydraulic bending and rolling, controlled rolling of plates and pipes, and research in new types of steel for various sectors of the national economy and national defense industries, designs and corresponding techniques to produce materials for machinery and weapons. Most of these research projects belong to applied research and developmental research, but in addition some basic research has been launched, such as studying physical and chemical reactions in the separation of elements, mass and thermal conduction in the blowing process, deformation and phase changes in pressurized processing and some related basic research in new materials. Research funds mostly rely on business funds, there are also some funds for the three projects and capital construction funds. In the past, administrative methods were the main methods to assign tasks and to popularize results in a way called the "three alliance of scientific research, production and use." This was the traditional procedure.

At present, it seems that this system and management have the following five problems: One, the problem in the source of tasks. At present, the national economy is in a period of readjustment. Scientific research work must serve the enterprises in developing potential, in reform and in improvement. The key enterprises mostly have sufficient research strength and they do not need or rarely need the participation of the research academies and institutes of the industrial sector. There are problems in digesting and popularizing some imported projects, but most imported projects involved the participation of scientific research departments from the beginning. Preresearch type tasks could not be easily developed because of less funds and slow results. Two, the problem in funding. In 1981, business funds (except wages) dropped by 20 to 30 percent from 1980. Some scientific research projects (such as the application of isotopes in metallurgy) could not be developed easily because of insufficient funds. Three, the problem of purchasing equipment. Most of the research academies and institutes of the industrial sector were developed during the 1950's. At the time, investment was large and the equipment was new. After more than 20 years, there were no depreciation costs, capital construction could not be included, and it was difficult to replace the equipment. At present, the equipment and instruments have lagged behind those of the research units subordinate to certain enterprises with expanded autonomy. The superiority of the equipment and facilities of the past has been gradually lost. Present funds cannot solve the problem of purchasing equipment. Four, the problem in the structure of manpower. The average age of scientific and technical personnel is over 40 years-old and technical workers are gradually aging. In recent years, the proportion of nontechnical personnel has enlarged. They could be hired but they could not be assigned elsewhere. More and more people have been hired and the percentage of scientific research personnel has become smaller. Five, the problem of the distribution system. The business units subordinate to the scientific research departments do not have a source of monetary awards. To open up new sources of money for awards requires organizing technical services or small-scale production. Scientific and technical personnel cannot directly participate in activities realizing economic income and their awards

are less than productive personnel. The phenomenon of "eating from the big pot" still exists. The present backbone scientific research personnel over 40 years-old often have less income, their living quarters are crowded, their burdens are heavy, and there are many actual problems that are related to the distribution system.

The situation in the research academies and institutes of the industrial sector has created many difficulties for organization and management. Therefore, the research academies and institutes of the industrial sector urgently need to create a new path in readjustment and information. In this regard, there are many policy questions that need to be explored. In the following, we will present some ideas related to readjustment and reform by combining the different types of systems with the present situation in the scientific research academies and institutes of the metallurgical system.

First, we suggest reorganizing and combining some research academies and institutes that have overlapping fields of specialization, that have a weak backbone in science and technology and poor conditions for scientific research experiments. Some research units involved in information gathering, standardization, measurements, thermal energy technology and safety technology that are comprehensive in nature and that also have concurrent functions can still remain directly subordinate to the ministry and the commissions. Some research academies and institutes that are more strongly specialized can consider implementing joint scientific research and production and become subordinate to a certain enterprise or be combined with research institutes of the same enterprise. Comprehensive research academies and institutes cannot just serve one factory because the scope of research is broader and because a factory has more specialized facilities, and it is very difficult for a factory to take in such a comprehensive research department. Therefore it is not suitable to establish a joint establishment to engage in scientific research and production. Our idea is whether a comprehensive research institute can be placed under the leadership of the ministry and the commissions and be jointly operated by several large companies or factories and mines. Each large company or factory and mine can assign capable personnel to organize a board or a committee to lead and supervise its nature, policy, direction and establish its tasks and oversee their execution so that they can develop major scientific research work for the buildup of production of the nation's enterprises. The funds can be shared by the large companies or the factories and mines according to output. For example, for every ton of steel produced, they can provide 1 yuan for scientific research, then an annual output of 30 million tons of steel would provide an annual scientific research fund reaching 30 million yuan. The leadership of such research academies and institutes can be nominated and commissioned by the above described board or committee and be approved by the ministry and the commissions. The research academy or institute jointly established and operated will necessarily be controlled by the production enterprises and serve the production enterprises. At the same time, because the research direction is of a comprehensive nature, it can be differentiated from the research academies and institutes subordinate to the enterprises.

After such reforms in the system, it is estimated that the research academies and institutes of the industrial sector will bring about the following benefits. One, the scientific research task will be further combined with the buildup of production. Because the research units are joint ventures of large companies or factories and mines, their research direction will necessarily be controlled by these enterprises. The scientific research tasks will necessarily be aimed

at serving the present and long-range needs in production and production buildup of the enterprises. At the same time, they are also beneficial to the popularization of scientific research achievements so that they can be converted more quickly to productive forces. Two, the problem of scientific research funds can be solved more easily. At present, most academies and institutes do not have intermediate experimental factories. Many scientific research achievements in steel and iron production techniques cannot be proved industrially within the academies and institutes, and it is even more difficult to realize economic results. If the above readjustment and reforms are made, it would be possible for scientific research academies and institutes to receive funding from enterprises. The application of scientific research achievements in the enterprises can be guaranteed. This large area economic accounting is more rational than small-scale economic accounting. In addition, after reorganizing and combining some academies and institutes with overlapping specializations, scientific research funds will be utilized more rationally while the state's financial allocations will not change a lot. Three, technical equipment can gradually be renovated and replaced. Technical equipment is one of the important conditions of scientific research work. Especially when research academies and institutes of the industrial sector engage in the research in production techniques, it is very difficult to accomplish scientific research tasks without relatively advanced technical equipment. In the present system, the cost for purchasing scientific research equipment constitutes only 18 percent of business cost. Our academy's fixed assets have already approached 100 million yuan, but each year, the cost of purchasing equipment is only 1 million yuan, constituting 1 percent of our fixed assets. The visible wear of scientific research equipment is not as fast as that of productive equipment, but invisible wear is relatively fast. Our academy handled 293 units of machinery that were returned to the warehouse in 1980. The original price was 1.55 million yuan, but after a price change, the income was only 40,000 yuan. The funds of scientific research units to purchase equipment cannot even cover depreciation and they cannot even talk about renovating and replacing equipment. Some funds for the three projects are restricted as special funds for special purposes. They are mainly used to purchase special equipment while funds for the purchase of much general purpose equipment for scientific research departments are not available for many years. Thus the development of technical equipment throughout the academy was unequal. Even if there were some capital construction investment, it was mainly used to build dormitories, and there was no push to purchase equipment. After reforming the system, scientific research funds will be guaranteed and this will help the renovation and replacement of technical equipment. Four, it can better the enthusiasm and creativity of scientific and technical personnel. Talent is the key dynamic factor in scientific research units. It symbolizes the potential and the standard of scientific research units. Now, the main problem is that we cannot select and hire the best, we cannot rationally transfer them, the enthusiasm and the creativity of scientific and technical personnel have not been fully developed, "eating from the big pot" and "egalitarianism" still exist. In the present personnel system, it is very difficult to select and hire the best and realize a rational transfer of personnel. If this problem is not solved, it will be very difficult to improve the personnel structure and the development of the intellect, and solve such problems currently existing in scientific research units. Although wages and the system of encouragement are a factor in mobilizing and developing the enthusiasm and creativity of currently available scientific and technical personnel, the more important factor is still whether we can give them attractive scientific research tasks so that they can serve society and the economy effectively. Most scientific and technical personnel are strongly motivated to contribute toward the modernization of the motherland. If they can be given some scientific research projects that are meaningful to

the national economy and national defense industries, and if they can be given support by various sectors, they have great enthusiasm, and they will demonstrate their capabilities and increase their skills in scientific research work. Now, it is exactly this problem that has not been solved satisfactorily. After a reform toward joint operation by the enterprises, scientific research tasks can coincide more with production buildup, there will be better research conditions, research achievements will be popularized and applied in production in time, and the enthusiasm of scientific research personnel will be fully developed. At the same time, a joint venture system will also help the mutual exchange and rational transfer of scientific research and production personnel. Five, it will help improve the distribution system. Before the wage system is rationally reformed, the problem of distribution cannot be thoroughly solved. At present, there are many problems in funding monetary rewards by scientific research academies and institutes and the issuance of such rewards. Besides the very few major scientific research achievement awards and invention awards given by the state, monetary rewards are mostly provided by profits from small-scale production. In this way, frequently more monetary rewards are given to people directly involved in production while monetary rewards for the broad number of scientific research personnel are few and they are "fringe benefits" from production income. Because scientific research achievements frequently realize economic results during the course of production, the scientific research departments are not compensated. It is only possible rapidly to convert scientific research achievements into a productive force after the joint venture system is implemented. Then, a reasonable proportion can be taken out from economic gains as rewards. In addition, in the distribution of monetary rewards, we must also have different methods of rewards for different posts. And we must correspondingly carry out the series of fundamental work of clarifying duties and evaluating quotas well to overcome egalitarianism. There are many scientific research personnel who regard spiritual encouragement as more important than material encouragement. After scientific research personnel have made a definite contribution, necessary praise or appropriate promotion are frequently more useful than wages or monetary rewards. Besides wages and rewards, there are also problems with housing, vacations for workers and advanced studies, etc, which must be rationally solved.

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NATIONAL DEVELOPMENTS

READJUSTMENT PROBLEMS IN METALLURGICAL RESEARCH DISCUSSED

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[Article by Wang Gang [3769 6921] of the Heilongjiang Provincial Metallurgical Research Institute: "Preliminary Exploration of Several Problems on Local Scientific Research in Metallurgy During the Period of Readjustment"]

[Text] Our nation's regional metallurgy was gradually formed and developed from the emergence of local metallurgical industries during the latter part of the 1950's. Our nation's regional metallurgy consists mainly of medium and small steel and iron enterprises using a production method that combines Chinese traditional methods, indigenous methods and foreign methods. There is a visible local character. Therefore, our nation's regional scientific research in metallurgy oriented toward this type of method of production of steel and iron possesses the common characteristics of general metallurgical science and technology, and it naturally possesses its own fixed characteristics.

At present, local scientific research agencies occupy a definite position in our nation's scientific research system. In the metallurgical system, local scientific research agencies have developed greatly over the past 20 years and more. At present, besides Xizang, Qinghai and Ningxia and such frontier provinces and regions, almost all provinces, cities and autonomous regions have established metallurgical research institutes or steel and iron research institutes. Also, some large provincial cities have also established corresponding research institutes.

For more than 20 years, the broad number of workers and scientific and technical personnel of local metallurgical science research agencies have overcome various difficulties and done a lot of beneficial work through hard work and under the guidance of the correct line of the party. They not only created local metallurgical science and research, they also expanded such efforts and gradually developed them. They have also served unconditionally to support and promote the development of production by the local metallurgical industry. But, like local metallurgical industries, local scientific research in metallurgy was severely devastated during its course of development by the "Cultural Revolution." With the addition of our lack of experience in how to develop socialist science and technology, and our lack of conscientious research in borrowing related experience from other nations, there are still many shortcomings in many

aspects, even today. There are many problems that need further exploration and solution. I will discuss about my own shallow opinions on some problems in scientific research in local metallurgy during the period of readjustment based on my experience of many years in scientific research and my preliminary understanding of scientific research in local metallurgy.

I. The Direction and Tasks in Scientific Research

1. The determination of the direction of scientific research is an important prerequisite for research institutes to launch scientific research work. It is a major problem that must be considered first and solved in building research institutes. It is very obvious, if the direction of scientific research of a research institute is not clear or is not fixed, then unfavorable effects will be brought about in the buildup of its business and in the development of scientific research work. Abroad, this important question that affects the success or failure of a research institute and even the fate of the enterprise is handled very cautiously. For example, the direction of scientific research of the West German Production Research Institute and its key points of implementation are determined by a council consisting of leading members and the chairmen of all special committees of the German Steel and Iron Engineers Association. In our nation, the direction of scientific research of some large scientific research agencies, such as the academy of Sciences or the research academies and institutes subordinate to the industrial departments is discussed by the academic committee and reviewed and determined by the party committee. But according to preliminary understanding, except for a few of the local scientific research agencies in metallurgy (such as Beijing, Tianjin, Shanghai), many local scientific research agencies in metallurgy do not have a clear direction in scientific research, or more concretely, the principles seem to be clear, but actually the direction is ambiguous.

As a result, work is affected and the realization of achievements and the training of people are affected. According to what is known, some local metallurgical research institutes have been established for several years, but the agencies and the means of research are still incomplete and handicapped. The specialized organization of scientific research personnel and the composition of personnel could not be matched in caliber for a long time. Some scientific research work that needs to be launched could not be carried out. There are also some research institutes that have remained static for many years.

Our nation's policy of developing science and technology mainly emphasizes applied research and developmental research, and especially emphasizes the strengthening of developmental research in a big way and developing technical services. According to the division of labor of the various research agencies of our nation's scientific research system, the Academy of Sciences and the higher educational institutions should be mainly involved in basic research and applied research (with emphasis on the basics) while the scientific research agencies of the industrial departments and the localities should be involved mainly in applied research and developmental research. Research institutes of enterprises should mainly emphasize developmental research. In connection with the local metallurgical industry, medium and small enterprises generally do not have their own special research agencies while the central laboratories

of the enterprises (medium enterprises) or laboratories (small enterprises) generally cannot carry out research work except the daily task of inspecting production. In view of this, our nation's situation is similar to that abroad. For example, most of the medium and small companies in France do not have research laboratories. Even under the best situation, they are limited to having only some inspection--testing groups. There are only a few enterprises that own first class laboratories. Also, for example, the West German Government believes that it is too much of a waste for medium and small enterprises to establish their own research laboratories and they do not have the means. On the other hand, there are no constant research tasks, and the difficulty of some research subjects cannot be overcome by the enterprises themselves. But these enterprises frequently must solve the problems that they encounter by scientific research, therefore, they must commission other departments to conduct research and development of special projects or conduct cooperative research. Therefore, we can believe that local metallurgical research institutes also possess the nature and functions of the research institutes of metallurgical enterprises. Therefore, they should mainly engage in applied research and developmental research with special emphasis on developmental research.

As a local metallurgical research institute, its direction in scientific research must also grasp the local resources of metallic ores, the characteristics of the technical equipment and the technological processes of local metallurgical enterprises, and the characteristics of market needs for local metals or the direction of the products of local metallurgical enterprises, and persist in the direction to serve production of local metallurgical factories and mines. To enable scientific research to lead production and to provide technical reserves for local metallurgical enterprises, the local metallurgical research institute must carry out research in metallurgical raw materials and it must carry out research in metallic materials. Both are necessary.

2. The tasks of local scientific research agencies in metallurgy can be separately determined as near-term and long-term tasks after clarifying the direction in scientific research. Near-term tasks must closely surround efforts of local metallurgical enterprises to develop potential, their efforts in renovation and improvement and their efforts to increase output and income, and the research tasks must adapt to the needs in reorganizing the enterprises.

It should be pointed out that most of the local metallurgical enterprises have backward production technologies, the equipment is outdated, the means of inspection and testing are very simple, the waste of energy is serious, and environmental protection work is very weak. As a result, the quality of the products is low, the cost is high, and output cannot be increased. Therefore, local scientific research agencies in metallurgy must face this reality and exert efforts to renovate production techniques, rebuild metallurgical equipment, improve the quality of the products, conserve energy, carry out comprehensive utilization, improve the environment, and improve testing techniques, etc.

The study of new materials, new techniques and new equipment are the three pillars of our scientific research in metallurgy. Therefore, when local metallurgical research institutes carry out the above tasks, they must also develop the popularization and application of new technology and new techniques, test produce or develop new materials, and they must pay attention to the study of comprehensive utilization of local resources.

Local scientific research agencies in metallurgy should especially emphasize the study of rebuilding equipment. The neglect of rebuilding equipment is more outstanding in local metallurgical enterprises. On the one hand, the original equipment is outdated, and on the other hand, they have blindly copied and imitated, thus the funds for technical measures are being used year after year while the condition of the equipment have not visibly improved. This requires local scientific research agencies in metallurgy to strengthen studies in rebuilding equipment in a big way to provide more effective technical services for the renovation of equipment of local metallurgical enterprises.

When determining the tasks, we should also consider expanding the clientele serviced. We must not serve only the local metallurgical enterprises, we can also directly shoulder the tasks of test producing and developing metallic materials needed by such sectors as the local light industry, textile industry, electronics industry and building materials industry. We can seek ways for the local metallurgical enterprises to expand their product varieties. When the conditions allow, we can also expand our service clientele to outside the province and accept scientific research and test development tasks commissioned by sister provinces or the Ministry of Metallurgical Industry.

II. The Establishment of Research Agencies

The establishment of research agencies is a guarantee for organizing scientific research development. For local scientific research in metallurgy, we lack experience in establishing agencies to adapt to the needs of such work, and there are no similar cases abroad for us to refer to. According to what is known, the Soviet Union has only two levels of scientific research agencies in metallurgy, the national agencies and the agencies belonging to the republics. Each level is divided into two categories, one belonging to the science academy system and the other belonging to the industrial sector. Metallurgical research institutes of major capitalist nations such as the United States, Japan and West Germany, can be generally divided into three types: Those belonging to the national industrial sector, research agencies belonging to the higher educational institutions and those belonging to metallurgical enterprises. For example, the Metallurgical Research Center of the U.S. Mining Bureau, the Metallurgical Research Institute of Japan's Tsusansho (International Trade and Industry Ministry) and West Germany's Special Research Agency (such as the Max Planck Steel and Iron Research Institute) belong to the first category. Regional metallurgical research agencies like those in our nation can be said to be unique in the world. According to the present situation and based on development, we need to explore the establishment of two-level agencies. One is the establishment of the research institute itself and the second is the establishment of interior agencies of the research institute.

1. On Establishing the Research Institute: The distribution of resources of metallic ore in each region is different. This creates an imbalance in the development of local metallurgical industries. Thus, the necessity of establishing local scientific research agencies in metallurgy is not consistent. Therefore, when considering establishment, we must suit measures to local circumstances. But, in view of the actual situation in each province, city and autonomous region at present, almost every locality has established a metallurgical

research institute, and some provinces also have two levels of research institutes belonging to the province and the cities. It is worth discussing whether this is necessary. Take Heilongjiang as an example. In 1972, it prepared for the establishment of the provincial metallurgical institute. After 7 years, when the provincial institute was still being built, Harbin City also built a metallurgical research institute. Now, the specialized organization and the caliber of personnel at the provincial metallurgical institute are still not complete. Although it has done some experimental research work during the course of development and it has realized some achievements, but they are far from satisfying the demands for scientific research by the local metallurgical industry. The city's metallurgical institute has been established for 2 years, and it now has over 10 workers. It does not have a laboratory and means of testing and up till now, it could not carry out scientific research work. Such situations not only exist in the province of Heilongjiang alone. The reason for such overlapping agencies is related to our current management system. At the same time, it is also related to the long period of feudalist influences in our nation. Our view of this situation is that we should be determined to reorganize it during the period of readjustment. The first step can be to start out from the actual situation in each province, to take care of the historical situation, select and keep those with better conditions and concentrate manpower, materials and finances of the province and the cities to operate such institutes competently. We must not engage in formalism, purely pursuing large numbers of such agencies, putting up fronts without seeking actual results.

Because most scientific research agencies in metallurgy have a weak foundation, backward means and weak technical strength, and because of various reasons, their development has been limited. In addition, in the provinces, generally speaking, the local metallurgical industry is not developed. To bring out the advantages to make up for the shortcomings and to develop superiority, scientific research strength should be formed into a "first." We believe, the second step can be to take the large area (or economic cooperation zone) as the unit based on the actual situation at each locality, to join the metallurgical research agencies of each locality with the zone to form a large area metallurgical research agency which will serve medium and small metallurgical enterprises within the large area. To facilitate work, we can consider placing the metallurgical research institute of the large area after consolidation under the leadership of the Ministry of Metallurgical Industry.

2. The Establishment of Interior Agencies of Research Institutes: After clarifying the direction and tasks of scientific research, the research institutes must begin work with a fixed organization, i.e., the research laboratory, the testing laboratory and the subject group. Therefore, the establishment of research agencies must correspond to and be coordinated with the direction and task of scientific research to promote the completion of research tasks and thus to realize the direction of scientific research. According to foreign experience, research institutes have three organizational forms: by academic discipline, by function and composite organization.

The establishment of research organizations by discipline is relatively simple but the shortcoming is that when a complex research topic is encountered, the heads of each special research laboratory cannot shoulder the entire research responsibility, even when temporary coordination groups are organized under the sponsorship of the head of the research laboratory, it is still difficult for them to work in coordination and frequently, the director of the research institute has to push the work ahead. Therefore, besides the research institutes engaged in basic research and applied basic research, this organizational form is generally not used. According to understanding, most of the research institutes (such as the Metals Research Institute) of our nation's Academy of Sciences system use this organizational form. Research organizations established by function have a definite versatility in carrying out work and it is easy to organize researchers of different specialties into cooperative research groups according to plan. Management is relatively convenient, but the shortcoming is that redundant personnel and equipment are easily created. Those established by function can also be divided by product (such as alloy steel, high temperature alloys, precision alloys, difficult-to-melt metals) and by productive procedure (such as mining, ore selection, sintering, iron smelting, steel smelting, steel rolling). Most of the research academies and institutes of our nation's industrial sector use this organizational form. The so-called composite form involves the establishment of a unified technical service department (such as common laboratory) within the research institute. This form is the common trend in all nations. It can to a certain degree overcome the shortcoming of redundant personnel and equipment, and it can improve the work efficiency of scientific research personnel and the rate of utilization of equipment.

Local metallurgical research institutes generally divide their research laboratories by function. We believe, in the future, as work develops, they should gradually change toward the composite organizational form to centralize general means of testing and establish a unified technical service department or a common laboratory for use by all research laboratories and all groups of the whole institute. This is very beneficial for fully utilizing equipment, conserving capital, and developing the scientific research potential. Foreign nations already have relatively advanced management methods in this aspect. They advocate common use of large instruments and equipment, and the key laboratories are opened to the public. For example, the Ames Research Center and the Fermi National Laboratory of the United States not only provide facilities for domestic scientific research personnel to perform experiments, they are also open to foreign scientists. But, according to understanding, now, a lot of the experimental research equipment of the departments and units cannot be fully utilized because of irrational management systems. There is even one unit that has internal experimental equipment that cannot be used by everyone and it is left unused and others are not allowed to use it. This bad style of departmentalism is not compatible with the superiority of our socialist system. We should advocate cooperation in a big way, provide mutual assistance, establish special management for public use in the management system, regulate the surplus and the deficiency to develop fully the function of currently available experimental equipment.

III. Concerning the Popularization and Utilization of Scientific Research Achievements

Scientific research achievements are the results of hard work of the broad number of scientific and technical personnel. They are the precious wealth of mankind. They are the material foundations and the indispensable reserves of resources to build a modern and strong socialist nation.

Before scientific research achievements are popularized and applied, they only manifest themselves as a productive force in the form of knowledge. They are potential and indirect productive forces. To convert them into practical and direct productive forces to satisfy social needs, we must conscientiously popularize and apply them well.

Foreign nations place a lot of emphasis on the popularization and application of scientific research achievements. For example, the U.S. Government and Congress both emphasize that scientific research achievements must be rapidly applied to realize economic results. Private American businesses take the initiative to establish broad and effective cooperation with the universities and research agencies to improve the competitive ability of the products and to seek maximum profit so that "scientific research--technological development--production and use" are tightly combined. The channels are not blocked, and scientific research achievements are rapidly applied. This is a very important factor that pushes the development of American social productivity ahead. A report by the International Development Association states: In the United States, about 80 to 85 percent of scientific research achievements are in time used in production. Its heavy industry undergoes technological renovation an average of every 5 years. The rate of utilization of scientific research achievements in Britain, France and West Germany is 50 to 65 percent. In major capitalist nations, special management agencies have been set up to popularize scientific research achievements. For example, the Steel Research Institute of U.S. Steel (USS) has set up an office for the popularization of research achievements and technological logistics conditions. The West German Steel Association established the "Steel Technology Promotion Association" and the "Association for the Promotion of Scientific Research in Steel" in 1954 and 1966 respectively. They are responsible for gathering, guaranteeing and economically evaluating the scientific research achievements of the committees and research institutes and popularizing them in production.

In our nation, the popularization and application of scientific and technological achievements in production are still weak links. Many scientific and technical achievements are still at the stage of samples, exhibitional products and gifts, and they have not been popularized and applied. According to surveys, in our province, during the 10 years from 1969 to 1978, the percentage of scientific and technological achievements popularized and applied in production constituted 47 percent of the total number of scientific and technological projects completed. There are also some scientific and technological achievements that have already been applied but have not established themselves, and the actual percentage of utilization is only about 30 percent. The percentage of experimental research achievements over the 9 years since the founding of our institute that have been popularized and applied is only 29 percent.

Although there are many causes that affect the popularization and utilization of local scientific research achievements in metallurgy, according to our experience, there are mainly the following:

1. There are many gaps between metallurgical production and scientific research work. In the planning and management system, production plans and scientific research plans are managed separately by different administrative departments. And these administrative departments frequently "fight their own battles" and do not communicate with each other when drawing up or reviewing plans.
2. The current management method, policies and regulations frequently affect the popularization and application of scientific and technological achievements. For example, the current price policy does not include the principle of demanding good prices for superior quality, thus when the enterprises utilize scientific research achievements, although the quality or performance of the products has been improved, but the products cannot realize true benefits, therefore, the enterprises are unwilling to pay the price to utilize scientific research achievements. Two years ago, our institute took on the task of studying the selection of troilite ores within the province. As a result, the sulfur content of the troilite ore was raised to about 35 percent in the sulfogen ore and this provided superior quality fine raw material for the sulfuric acid plant and this also created the prerequisite conditions for the comprehensive utilization of iron in sulfuric acid slag. But because the price policy was unreasonable, the work spent at the ore screening plant was not compensated for but was punished. This caused a loss and this scientific research achievement was not popularized and applied in production. The enterprise also did not realize any gain because it did not have this scientific research achievement.
3. The leaders of the enterprises and the economic departments still have a definite lack of understanding of scientific and technological work. They have not clearly understood ideologically the organic link between science and technology and production. The popularization and application of scientific research achievements are comprehensive tasks with a very strong planned character. More manpower and materials are needed during this stage, and according to some statistics, the ratio of the funds required for research, development and popularization of achievements is 1:10:100. This shows that the price that has to be paid increases as research approaches the stage of material production. The present situation is that although the application of one scientific research achievement may realize economic benefits several times, a dozen or so times and even several dozen times the investment in scientific research, but leaders of some of our enterprises seem to linger habitually in a passive production situation, and they are unwilling to spend the funds under their control for scientific research work.
4. The lack of intermediate means of testing thus creating a gap between scientific research and production is also one of the reasons affecting the popularization and application of scientific research achievements. If an applied research achievement lacks complete and reliable test data, then even if achievements of intermediate stages are successful, they are still difficult

to popularize. Not doing things according to scientific research procedures and not carrying out intermediate tests, anxiously seeking success and blindly entering into industrial production frequently will not reach the expected results. On the contrary, serious waste of manpower and materials will be created. There is much experience and many lessons in this regard. Local scientific research units in metallurgy frequently cannot establish intermediate means of testing in time during the course of development because of various reasons, or the intermediate testing agencies are not sound. All such units should establish and make sound the intermediate testing plants (shops) as early as possible to stimulate the scientific research achievements of the units themselves so that the achievements can be quickly converted to practical productive forces.

In the long-range view, considering the establishment of joint organizations for scientific research and production to adapt to the needs of economic development is an effective way to overcome the gap between scientific research and production. In this regard, foreign nations have had more mature experiences a long time ago: Since the 1960's, the United States has established 115 joint companies for scientific research and production. The Soviet Union has established over 130 joint scientific and productive entities. The local metallurgical research institutes that have better conditions can select related enterprises and designing departments for joint ventures and organize joint companies for scientific research and production so that they can become the regional centers of metallurgical science and technology. This direction of development should be carried out cautiously, deliberated on fully and prepared for fully before implementation.

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NATIONAL DEVELOPMENTS

COMPREHENSIVE PLANNING, SCIENTIFIC RESEARCH MANAGEMENT REVIEWED

Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 3, July 82
pp 28-34, 60

[Article by Liang Jiangli [2733 3068 4539]: "Comprehensive Planning and Management of Scientific Research Units*"]

*Author's note: Liu Haizhen [0491 3189 2182], He Guoguang [0149 0948 0342], Chen Lan [7115 1526], Zhang Jingyuan [1728 2417 0337], Cao Nianci [2580 1819 1964] presented many valuable opinions for this article, deputy director Tang Shiji [0781 1102 0679] carefully reviewed it and made some revisions.

[Text] The function of scientific research management mainly involves planning, organization and control. The form of management is an upward spiraling cycle consisting of planning, organization and control. It converts input resources into output.

The management of research academies and institutes can be divided into three levels. The first level includes decisionmaking and establishing plans. It is the high level managerial level. The second level is the middle management level and it mainly involves drawing up plans and organization. The third level is the implementation level involved with the concrete implementation of plans.

The fundamental task of scientific research management of research academies and institutes is to forecast the trend of development based on the trend of development of modern science and technology, accurately select the goals of scientific and technical research, establish plans for one's own department and for one's own profession based on the party's principles and policies and state plans, organize one's own plans and implement them, study management systems, train and select scientific and technical personnel, guarantee the source of funds, materials and laboratory equipment, fully develop currently available scientific research capabilities, obtain the best results at the least price, serve the modernization of the national economy and national defense.

The objects of modern scientific research management are mostly huge and complex systems. Scientific research management must organically organize three means (man, agency, law) and four subjects (man, money, material, time) before the best management can be implemented.

The research academies and institutes are a complex scientific research system. They mostly consist of so-called subsystems of such departments as the scientific research command headquarters, technical services, material supply, logistical guarantees. The subsystems can be further divided into smaller subsystems. To produce more results and more talent, these subsystems must operate in coordination before scientific research capabilities can be unified and coordinated. This requires a common criteria for action and a common goal, the implementation of comprehensive management, and comprehensive plans to serve this function. With a comprehensive plan and with corresponding diagrams, we can directly view and understand the mutual relationship among progress, materials and funds for scientific research in the entire scientific research process. Managerial personnel at each level can easily understand the relationship between the local situation and the overall situation. The key problems are clear, measures can be taken easily and inspection and examination can be conducted easily. A good comprehensive plan should be progressive, strict, unified and versatile. Whether a comprehensive plan has been drawn up well and executed well is an important indicator of the level of management of a scientific research unit.

I. The Basis for Drawing Up a Comprehensive Plan

Comprehensive plan refers to the plan drawn up around scientific research tasks to balance comprehensively the progress in scientific research, the distribution of materials, training of personnel, technical measures, and the means and equipment for development.

The basis for drawing up comprehensive plans is the political line, principles and policies of the party and the state to develop science and technology, state plans and social needs, the trends in scientific and technological development, the social results of science and technology, forecasts of the developmental trends in social needs, and scientific research capabilities.

The research subjects we pursue include tasks assigned by the state, contract tasks proposed by the users and stipulated in our contracts, tasks selected ourselves and arranged by ourselves according to the direction stipulated by the academy and institute or those tasks to satisfy social needs. Regardless of the nature of the tasks, we must prove the worthiness of the tasks and conduct feasibility studies. They must clarify the following:

- (1) the source of the task;
- (2) the purpose and significance of development or production;
- (3) similar domestic and foreign products, the level of achievement and the developmental trends;
- (4) the content, major technical specifications, the way to realize the task, the product model to be developed and produced;
- (5) the divisions and progress of the stages of development and production;

(6) whether there are any key technologies and key equipment and the methods to solve them;

(7) how much technical strength is needed, how to solve the lack of such strength;

(8) whether there are any sources of funds, what are the economic results;

(9) whether there are official agreements and contracts.

As economic management is strengthened, contract tasks will become the important content of planning and management. Scientific research contracts are contractual agreements for the research units to provide products and results to society or users. The contract flow process generally involves negotiating and signing contracts, the implementation of contracts, the completion of contracts and final inspection and delivery. A contract is generally of the following types: "research contracts" of research tasks commissioned by external units; "developmental contracts" of developmental tasks commissioned by external units; "transfer of results contracts" to sell scientific research results or to transfer new technology; "technology services contracts" to serve external units by utilizing the institute's instruments, equipment, testing conditions and processing capabilities; "product supply contracts" to provide products to external units; "cooperative contracts" for joint development in cooperation with related units; "consulting contracts" to provide technical consultation to related units.

In drawing up comprehensive plans, assigned tasks and contract tasks or self-selected tasks must be uniformly considered and arranged on an overall basis.

II. Several Relationships Must Be Correctly Handled in Drawing Up Comprehensive Plans

(1) The Relationship Between the Need and the Possibility

The tasks included in the plans must be understood on an overall basis. The scientific research capabilities of one's own unit must be analyzed on an overall basis so that the plans are established on a reliable foundation. Some tasks that are needed by the state and by society should be firmly included in the plans when conditions are present. If a research unit does not possess the conditions to perform some tasks, it must actively create conditions. If one has the conditions to perform some tasks but the users are not defined, the usefulness is not clear, and if the tasks do not have a future for survival, then they should not be included in the plans.

When making arrangement for plans, we must consider input conditions (current capabilities) and output conditions (the goal to be reached). We must grasp the inheritability factor, the investment factor, economic gain and priority principle. Only in this way can the comprehensive plans thus drawn up truly be feasible.

The inheritability factor refers to the comparison between the experience and knowledge accumulated in the past that can serve as a reference in performing the new assignments, and the new experience and knowledge that have to be initiated. The new experience and knowledge that have to be initiated should be limited to within a definite range so that there will not be too many new demands and so that the task can be completed in time. Neither should one be too conservative to avoid efforts that are too few, too slow, too poor and more costly.

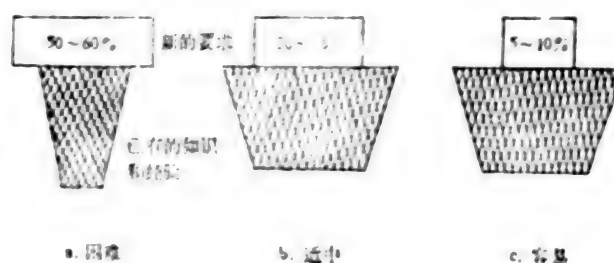
In general, there are the following three situations:

50-60% New demands

Already acquired knowledge and experience

(a) difficult

(b) moderate (c) easy



In (a), because there are too many new demands, there will be a lot of difficulties in development. We should first arrange research to overcome the technical difficulties and then carry out development. This would be more suitable. If we do not do this, then, the larger number of technical difficulties will greatly delay the period of development. In (b), new demands constitute only 20 to 25 percent. Developmental plans can be arranged, developmental contracts can be signed with user units, and the task can be completed in time with confidence. In (c), there are fewer new demands, most of the task, a suitable inheritability coefficient of comparison between the new task and the knowledge and experience we already possess for completing the task within a specific period is 75 to 80 percent.

Whether it is possible to complete the newly accepted task is determined by whether we have the investment. If we do not have investment, we should actively create conditions. Only in this way can we establish plans on a reliable foundation.

When considering the investment factor, we must also comprehensively weigh it in light of the economic results, social results and scientific value. When arranging scientific research tasks, we should consider the specialization and the interest of technical personnel as much as possible. The personnel must be few and skilled. A large number of people would not be beneficial to developing the enthusiasm of various types of personnel and would create difficulties in coordination.

The plans arranged should not be too tightly scheduled and neither should they be too loose. When they are scheduled too tightly, a high price may have to be paid. When the schedule of the plans is too loose, it would not benefit producing a lot of achievements and a large number of talent. The percentage of

tasks that must be completed should be set at 70 to 80 percent. The remaining 20 to 30 percent can be dynamic. If the task is completed, then it would be completing the plans with surplus. If the task is not completed, it would not affect the execution of the entire plan. If we set the task that must be completed at 100 percent, then even if we have to work overtime and use more work points, it is still possible that the task would not be completed in time.

(2) The Relationship between the Whole Situation and the Partial Situation

Scientific research plans cover the whole situation. Each job must follow the plans. The local situation must serve the whole situation. Work in agencies should be so and the relationship between the whole and the parts in engineering projects should also be so. Sometimes, problems exist in the local situation and affect the realization of the entire plan. This requires conscientious analysis. If the problem presented by the local situation is indeed rational, we should revise the whole plan by seeking truth from facts.

When drawing up plans, we must handle well the relationship among progress, scientific research funds and material supply. When the schedule is determined, funds and material supplies must be guaranteed. The schedule should not be affected by poor management of funds and materials. If the source of funds is insufficient and material supplies are not guaranteed, we should not blindly establish progress plans. We must establish the schedule on a reliable foundation.

To hasten the progress in engineering research and development, we must hasten the rate of material supply, and we may even increase expenditure. Therefore, shortening the period of development is not always the best in every situation. In a large system, even if a certain subsystem is completed early, it may not contribute to the entire system. Therefore, we must correctly handle the relationship among the three to realize the best results.

(3) The Relationship between Key Projects and Ordinary Aspects

When drawing up plans, we must handle the relationship between ordinary engineering projects and key engineering projects. The principle of arrangement should be "overall arrangement, guaranteeing key points." When funds and materials for ordinary projects and key projects conflict, we must guarantee those for the key projects. But in the key projects, not all jobs are key jobs. We must not emphasize the key points and neglect the arrangement of ordinary tasks. Among the nonkey projects, there are also key problems. If the key problems cannot be solved, the completion of ordinary tasks will be affected. Therefore, nonkey projects may become key projects. Therefore, key projects and ordinary projects are not necessarily unchangeable. When drawing up plans, we must handle them appropriately. When arranging the plans, sometimes we will feel that there are many tasks and the technical strength is insufficient. If this is not handled well, arrangement of some nonkey tasks may not be possible or the planned schedule may be delayed. We have such an experience. In completing one scientific research task, the percentage of the technical backbone force that truly realized a function was less than 30 percent. With the prerequisite of guaranteeing a necessary technical backbone force for key tasks, we can

arrange the weaker technical strength for nonkey tasks. This may better develop the function of this portion of technical personnel and this would be beneficial to the completion of the entire scientific research task.

(4) The Relationship Between Long-range Tasks and Near-term Tasks

To meet the needs of social development, scientific research units must make intellectual and technical preparations before they can continually expand their fields and ability to serve socialist buildup. When drawing up plans, we cannot just see the near-term projects that easily produce results and that have obvious economic results. We must have a strategic view, we must use appropriate strength and definite funds to carry out preliminary research, accumulate knowledge and make technical preparations. In this way, when a new task is assigned, it would be possible to reduce the initial technical requirements to the minimum and the risk factor, and confidence in completing the task will be greater.

For the research academies and institutes mainly engaged in developmental research, it is necessary to have an appropriate strength to engage in applied technical research and to pay attention to using the achievements of basic theoretical research.

(5) The Relationship Between Progress and Quality

The equipment and products developed by scientific research units must be good in quality and the time of development should be short. In the relationship between quality and progress, quality is foremost. Without quality, the product would not have any useful value. At the same time, under the prerequisite of guaranteeing quality, we must think of all methods which shorten the time for scientific research. Especially relating to national defense products, if we lose time, we lose the battle opportunity. Quality and progress should be unified.

In drawing up plans, conflicts between quality and progress frequently occur. This requires us to analyze the situation and solve correctly the problem. Under all situations, and regardless of what tasks are arranged, we must follow scientific research procedures. We cannot jump over a certain scientific research procedure. In carrying out some urgent projects, we must complete the task within a short period. When drawing up plans, our emphasis should not be on attempts to eliminate a certain developmental stage. We should actively organize forces, take measures, exert efforts to shorten the time for each stage in developmental procedures and realize the goal of shortening the entire development time. Some scientific research tasks require a high quality. The schedule is not too urgent. When arranging plans, we should organize experienced technical backbone forces to overcome the technical difficulties. We should not arrange to have too many technical forces too early to carry out ordinary jobs that do not include a lot of research.

(6) The Relationship Between Strictness and Versatility

After a scientific research plan is issued, it must be strictly carried out. But because there are many unknown factors in scientific research, when estab-

lishing the plans, we must allow a definite versatility. Subjects of different types must be differentiated in drawing up plans. Plans for research projects that are strongly theoretical must have a greater versatility. The plans for applied technical research must have a definite versatility. The plans for developmental research type subjects must be strictly executed. We must not only have annual plans, we must also establish quarterly plans and monthly plans.

Table 1

Planning and execution of plans of different types of scientific research

Type name	Basic line	Required versatility	Developmental research
Progress plan	Fixed numerical	definite versatility	Strictly controlled
Funding plan	Fixed	fixed	Strictly grasped (although additional funds are allowed, there must be sufficient reasons)
Material plan	Fixed	less strict	Accurate
Other co-ordinated plans	fixed	flexible	fully guaranteeing the execution of the plans

Because of the existence of uncertainties, there are cases when the plans are not executed. As we conscientiously handle them, we can reduce the loss to the minimum. Plans become ineffective generally in the following cases: that the plans become ineffective early, mainly because predicted conditions at the beginning when the plans were drawn up were not effective; or, on the other hand, it was known that the plans could not be completed, even from the beginning anyway. The other is that the plans occasionally become ineffective. This situation occurs mostly during the execution of a plan: the backbone team suddenly leaves, or when the key components suddenly malfunction and they can not be replaced within a short period of time. It is that a plan becomes ineffective after suffering losses. The second situation occurs during the execution of a plan when the measures taken have not been enough and the enthusiasm of the personnel has not been maintained.

When in the execution of plans, we must take corresponding measures so that the plans remain effective. The measures taken can be divided into temporary measures, adaptive measures, corrective measures and preventive

measures. The first three measures are taken after problems occur during the course of executing the plans. They are passive. When drawing up plans, we must consider the problems that might occur as much as possible and take preventive measures to reduce the risk of not being able to complete the plans. One percent of prevention is much better than 10 percent of remedies.

III. Subjects of Evaluation of Comprehensive Plans

(1) Scientific Research Plans

This is measured by the number of completed projects as a percentage of the total number of projects or the amount of work of the completed projects as a percentage of the total amount of work of all projects.

(2) Scientific Research Achievements

This refers to the quantity and quality of scientific research achievements, including products, equipment, and theoretical achievements. Scientific results, technical results, economic results and social results of the achievements must be comprehensively evaluated.

(3) Utilization of the Time of Scientific Work

The actual number of hours of scientific work as a percentage of the scheduled number of hours of scientific work is used to evaluate the degree of saturation of the amount of work.

(4) Material Consumption

Its accuracy, suitability and input and output rates are examined.

(5) Finances and Funds

The implementation of the budget, economic accounting, fluctuations in the cost of projects and products are examined.

(6) Training of Talent

How many people who have realized achievements have been trained, how many technical learning classes have been held, what are the results.

(7) Income from Scientific Research

At present, this mainly refers to the gain from products and the net gain from popularizing technology, providing services, cooperative processing, training of personnel.

The indices for evaluation of comprehensive plans include the seven subjects above. They do not constitute one goal but many goals. When comparing two scientific research units, the possibility that all seven indices of one unit are better than the seven indices of another unit is rare. Thus, examination

of comprehensive plans becomes more complex and difficult. This is actually a problem of evaluating multiple goals. To simplify the examination of comprehensive plans, the many goals can be converted to a single unified and comprehensively measurable goal, and thus we can evaluate the comprehensive plans.

1. The Weighted Method

For n goals $f_1(x), f_2(x), \dots, f_n(x)$, we assign correspondingly weights according to the importance of the goals $\lambda_1, \lambda_2, \dots, \lambda_n$. Then we form a new evaluation function where x represents different comprehensive plans.

$$U(x) = \sum_{i=1}^n \lambda_i f_i(x)$$

Based on such a formula, we assign weights to the 7 indices for examining comprehensive plans according to their importance and stipulate the value of each goal. Thus, as long as we know the actual value of completing the 7 indices, we can evaluate the completed tasks of a scientific research unit. The larger the value of the evaluation function $U(x)$, the better the task has been completed.

The weights and goal values stipulated above are standard for similar types of scientific research units. As long as we know the actual values of completion of the 7 indices of tasks performed by different units, we can measure the completed tasks, and units can be compared with each other. Units that have an evaluation function $U(x)$ of a large value are units that have completed the tasks well. If a definite value is not reached, we regard that unit as not having completed its task.

For example, the completion of two different comprehensive plans (respectively represented by x, y) is shown in table 5.

$$U(x) = \sum_{i=1}^7 \lambda_i f_i(x) = 1 \times 100 + 1 \times 50 + 0.7 \times 60 + 0.7 \times 30 + 1 \times 80 + 1 \times 30 + 0.5 \times 40 = 373$$

$$U(y) = \sum_{i=1}^7 \lambda_i f_i(y) = 80 + 100 + 56 + 80 + 60 + 15 = 391$$

Undoubtedly, the latter unit has completed its tasks better than the former unit. If we stipulate beforehand that a task is considered completed when $U(x)$ reaches 240, then the two units above are both considered to have completed their tasks well.

Table 2 Table of Weights

Importance	Weight λ_i
Very important	1
Important	0.7
Somewhat important	0.5

Table 3 Table of goals $f_1(x)$

Categorization of completion of plans	goal value $f_1(x)$
Very well	100
Well	80
Slightly well	60
Slightly poor	40
Poor	30

Table 4 Table of weights of indices

Examination indices	Weight
Scientific research plan	1
Scientific research achievements	1
Utilization of hours of scientific work	0.7
Material consumption	0.7
Finances and funds	1
Training of talent	1
Scientific research income	0.5

Table 5 Completion of Comprehensive Plans

Examination indices	Completion		Actual value	
	x	y	x	y
Scientific research plan	very well	well	100	80
Scientific and technical achievements	well	slightly well	80	60
Use of hours for scientific work	slightly well	slightly well	60	60
Material consumption	poor	well	30	80
Finances and funds	well	well	80	80
Training of talent	poor	slightly well	30	60
Scientific research income	slightly poor	poor	40	30

2. The Goal Method

We define a new evaluation function

$$U(x) = \sum_{i=1}^7 [f_i(x) - f_i^*]^2$$

where $f_i(x)$ -- the value of actual completion of the i th goal.

f_i^* -- the specified standard value of the i th goal.

According to experience, we can respectively stipulate the standard values of the 7 indices for examination. As long as we know the actual value of completion of the 7 indices by a certain scientific research unit, we can know whether that unit has completed its tasks well or not. The smaller the value of the evaluation function $U(x)$, the better the task is completed.

If the actually realized values of a unit are those listed in Table 7, then

$$\begin{aligned} U(x) &= \sum_{i=1}^7 [f_i(x) - f_i^*]^2 = (38 - 40)^2 + (10 - 15)^2 + (8 - 10)^2 \\ &\quad + (9 - 10)^2 + (10 - 10)^2 + (8 - 10)^2 + (5 - 5)^2 = 38 \end{aligned}$$

If for another unit

$$U(x) = 30$$

then of course, the one with an evaluation function $U(x) = 30$ has completed its tasks better than the one with an evaluation function $U(x) = 38$.

Table 6 Standard Values of Examination Indices

Examination indices	Standard value f_i^*
Scientific research plan	40
Scientific research achievements	15
Use of time for scientific work	10
Material consumption	10
Finances and funds	10
Training of talent	10
Scientific research income	5

Table 7 Actual Values of Completing the Examination Indices

Examination indices	Actually realize value $f_i(x)$
Scientific research plan	38
Scientific research achievements	10
Use of time for scientific work	8
Material consumption	9
Finances and funds	10
Training of talent	8
Scientific research income	5

IV. Organizational Agencies

The research institute as a system must have a comprehensive plan. The drawing up of a comprehensive plan requires a comprehensive agency. This agency is a committee by nature and it should have two functions. One is authority and the other is intelligence. The so-called authority function means that its decision is legally binding and related sectors must insist on executing it. The so-called intelligence function is to gather together talent from many sectors to form a brain trust to understand the level and trend of development of various professions in our nation and abroad. The brain trust must be able to organize and establish the direction of development and long-range plans for its own system. It must have a definite managerial experience and knowledge and be familiar with new management methods. To carry out these two functions, this committee must admit persons actually responsible for planning, equipment and finances and place them under the direct leadership of the institute director. It should periodically and occasionally study some major problems related to scientific research and production. The decisions made must be separately implemented. Within the comprehensive agency, only a few actual planning personnel are set up. Most of the other personnel can hold concurrent posts to reduce unnecessary echelons.

The tasks of this agency are:

1. To conduct systematic, comprehensive and analytical research in combining scientific research tasks and scientific research capabilities, to propose guiding thoughts for drawing up each plan;
2. To be responsible for drawing up long-range plans and comprehensive annual and quarterly plans;
3. To establish models for analysis of plans: to analyze the various elements composing the entire system; to summarize and balance the progress in scientific research, materials and funds; to propose various plans; to analyze their relationship and limiting conditions; to estimate risks; to select the best from many plans;

4. To establish an information feedback system, to discover problems in carrying out the plans on time, accurately and sensitively, to organize coordination and solution;
5. To organize and gather various kinds of data, information; to make forecasts of the direction and the tasks; to propose analytical opinions periodically or occasionally concerning the various aspects of the task and the progress in research and development;
6. To summarize and inspect the various stages of work well, and to compile comprehensive statistics and statistics on necessary special topics;
7. To organize exchange of experience and management methods for the application and popularization of science.

Because the work of the comprehensive department affects the entirety of scientific research units, therefore the position of the comprehensive planning department must be elevated objectively.

First, the leadership in charge of scientific research and production must concurrently serve as the leader of that department.

Second, the members of that department must possess authority above that of the deputy department chief.

Third, the major administrative policies of scientific research units must be proposed by that department, while suggestions or reports related to scientific research and production and proposed by other units must be submitted to that department.

Fourth, personnel must be few and skilled, they must be very familiar with the specialization of their own unit and they must possess rich managerial knowledge.

The comprehensive plan for scientific research is the utilization of the systematic and comprehensive principles of management. It will become larger as the scale of scientific research enlarges, the techniques will become more complex, the comprehensiveness will become stronger and it will attract more attention by the leaders in scientific research.

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NATIONAL DEVELOPMENTS

INSTITUTE URGES COMBINING MILITARY, CIVILIAN RESEARCH

Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 3, July 82
pp 61-66

[Article by the Nanhua Power Machinery Research Institute: "Exert Efforts To Carry Out the 'Three Transitions' Well and To Promote the Development of Scientific Research in Civilian Products in a Big Way"]

[Text] Our Nanhua Power Machinery Research Institute is a comprehensive design research institute serving the national defense buildup. It has several hundred engineers. The machinery and electrical staff is complete. It has a definite ability in test manufacturing, definite experimental conditions and means of testing. Conscientiously to implement, in order to serve national economic buildup, the policy of developing science and technology issued by the Central Committee, we insisted on combining military and civilian endeavors with emphasis on military endeavors. We exerted efforts to transfer scientific research technology from the laboratory to production, to transfer products for purely military use to both military and civilian use, to import foreign technology into our nation, and to strengthen scientific research management. We promoted the development of scientific research in civilian products, and enabled our institute to progress and develop steadily in economic readjustment.

(I)

In the past, we did not have a profound understanding of the important meaning of combining military and civilian endeavors. Some comrades believed that developing civilian products was an "extra burden" and was "not doing proper work." Some scientific and technical personnel worried that developing civilian products would "waste technology," "affect specialization," "be a blow to military industry." Because our institute had not been completed, and because it was a purely military production agency, because scientific research funding was cut back again and again, there were not many tasks, and for a while we were in a "half starving" state. Many jobs were unstable, discipline was lax, ideology was distracted. The entire institute was short of money. During the first half of 1979, the research laboratory rushed to divide up the scientific research funds, and by the 3d quarter, even money for automobile road tolls could not be paid. Facing this passive situation, we were faced with whether to progress further or retreat, whether to do something or to do nothing, whether to actively carry out readjustment or passively carry out readjustment.

We used the policy, which called for a tight grasp on readjustment and for stabilizing the economy, issued by the Central Committee as a guide, grasped the above problems and carried out repeated study and discussion. We gradually recognized that converting our purely military production structure in national defense scientific research to a scientific research structure that combined military and civilian endeavors, and expanding national defense scientific research are the objective requirements in the development of a socialist economy, and that they are long-range strategic measures to build up the four modernizations. They are also an important content of national economic readjustment, and thus we have improved our awareness in insisting on combining military and civilian endeavors, lifted our spirit, carried out the task of scientific research for civilian products under the prerequisite of guaranteeing completion of scientific research for military products, and realized a welcome step forward. Over the past 2 years, our institute has successfully developed our nation's first automatic bread production line for the food industry; transferred scientific research achievements of four types of precision testing instruments to civilian enterprises; developed the axis tracer for universities and colleges; provided a laser for holographic photography for educational use; drawn up blueprints for four improved models of automatic weavers for the light industry enterprises; developed the ball threader and the packaging machine for balls of thread; an automatic shaping machine for rail steel and a dynamic measuring meter to measure the change in direction of locomotives for the transportation sector; an emulsified asphalt mixing machine for the construction sector; a straw hat shaping machine for the commercial services sector; designed an automatic production line and trial produced medicated leaven and glutinous rehmannia for the medical sector; studied the continuous production technique for degumming ramie for the textile industry; studied the development of an inertia fire extinguisher to be used in tunnels for the coal industry. Additionally, we have provided technical services and technical cooperation, served as technical adviser to factories, opened up a road for scientific research of civilian products, opened up the situation, and fully manifested the technical superiority of the research institute.

As scientific research in civilian products developed, the situation at our institute profoundly changed. The move visible changes occurred in the improvement of our technical, production and management standards, in stimulating the enthusiasm of the broad number of workers to serve the motherland, in forming a good work style of conscientiously exploring and daring to create new things. We have transferred scientific research achievements and suitable technologies to the civilian sector, given internal support to the factories and enterprises to expand reproduction, created wealth for society, increased income, enlivened the economy, and promoted our own development. Over the past 2 years, we solicited funds on our own to build some of the urgently needed laboratories, strengthened supplementary accessories and replenished accessories which we lacked for the trial production line, and made up the serious deficiency in scientific research funds. We also improved collective welfare facilities and built dormitories and classrooms with our own funds. At the same time, we created a source for monetary awards for workers. Income increased, the workers' spirits rose, and civilized behavior became the new style of work.

(II)

In developing our institute's scientific research in civilian products, we grasped efforts to realize the "three transfers" of scientific and technological achievements satisfactorily, to promote the growth of society and the economy and to improve the scientific and technological standards as our important tasks. Thus effectively we shortened the time of development of scientific research projects, and hastened the popularization and application of scientific research achievements.

1. Develop Technological Superiority, Transfer Scientific Research Achievements and Provide Technical Services

To enable the techniques of scientific research to enter the laboratory and the realm of production, we transferred concrete scientific research achievements to the factories one after the other. The ZZP-5310 noncontract type displacement amplitude meter which was developed by our institute and which was cited and given an award by the National Science Conference, the DZY-1 multipurpose tachometer and the ZZP-6 six-channel vibration meter, the TD-7834 precise frequency direct current converter which were given the provincial scientific technology awards were transferred to the factories for production. They forcefully promoted the development of these enterprises. For example, the ZZP-5310 noncontract displacement amplitude meter can be broadly used to measure vibration and displacement in steam turbines and water turbines. The technology is advanced, the products are of superior quality and suited for the market. After transferring production to the Hangzhou Automated Instruments Factory, it became the "product with a punch" of that factory. This 1 scientific research achievement created over 3 million yuan in production value for this small factory which had over 120 workers and which could not even afford several hundred yuan for travel expenses. A factory was thus saved.

To develop the potential for trial production of the research institute and to contribute to the national economy, our institute readjusted the product structure of the trial production line, enabled the trial production shop to increase its production of large quantities of scientific research products for civilian use, to carry out intermediate production tasks and change the past situation of only providing test parts for the research laboratory. The tasks increased from the past institution of "not having enough" to "having too many."

In face of the heavy production and trial production tasks, the broad number of production workers lifted their spirit, courageously shouldered the tasks, cooperated with one heart, worked hard, worked overtime and worked for more work points. Because everyone dared to think and dared to act and worked pragmatically, the trial production shop was able to guarantee the task of manufacturing military products and also was able to complete manufacturing up to a hundred units of test products and in small batch production throughout the year. The designs of the scientific and technical personnel were quickly tested in practice and wealth was created for society.

To develop the superiority and potential of the technology, the experimental equipment and the means of testing at the research institute, we took the

initiative to orient ourselves toward production, courageously served as technical consultant to factories, and helped factories overcome key problems in production. For example, Zhuzhou City's Switch Factory took up the task of trial producing and processing a number of process control cabinets. Because the technical strength was insufficient, the products could not be tested and delivered. We took the initiative to send engineering and technical personnel who have involved in testing for many years to the factory to help test the products. Aimed at the problems in the design, we changed part of the logic circuits and added some measures and conducted laboratory simulation tests according to the designed requirements. These products reached the designed specifications and the performance was stable. At the time the products left the factory, their design, use and manufacturing were all satisfactory, and they also satisfied the urgent needs of the Gezhou Dam project. Now, that factory regards our institute as its "technical backup" and it now dares to accept orders for manufacturing technically complicated electronic equipment. We also took the initiative to orient ourselves toward the development of technical services on a broad basis in society. In recent years, we have conducted tests of the fuel oil regulator and the torque sensor for the Xiangjiang Machinery Plant, conducted tests for the pneumatic execution mechanism for the Hangzhou Steam Turbine Plant, conducted blade regulator tests for the 703 Institute, and conducted tests of the torque measuring mechanism for the General Xiangxi Instruments Factory. This year, we have also trained experimental personnel in laser holographic photography equipment for 17 units in the province and outside the province to grasp the principles and experimental techniques of that scientific research achievement. In recent years, we have inspected and repaired over 80 precision testing instruments for nearby city and county enterprises and business units so that these instruments and meters that did not meet operating requirements were restored to their original technical state and so that the quality of the products had a reliable guarantee.

2. Transplant Military Products Technology in a Big Way, Hasten the Progress of Scientific Research of Civilian Products

Our institute has transplanted the production techniques of military products in a big way ranging from design, technological flow and the selection of materials in scientific research in civilian products. For example, the automated bread production line developed for the Zhuzhou Bread Factory involved the massive use of a military scientific research achievement--the electrical eddy sensor--in measuring fluid materials, cutting, canning and in the main synchronous transmission for the automatic production line. This was simple, economical and also suitable and reliable. Military hydraulic pressure technology was used in the power equipment of the rotary plate for continuous fermentation in the automatic production line, the pouring of noodles from containers and automatic adding of flour, braking and lock opening, totaling eight intermittent maneuvers. This simplified complex mechanical structures and reduced electricity consumption. The technology of regulating automatization of sprayers, which was developed for military products, was used for spraying oil inside cans. The old was sprayed evenly and this conserved oil, etc. Because of the massive application of military technology, a lot of redundant labor was eliminated, the time of scientific research was shortened, and in only 2 years, the automated production line in food technology was completed. The work in-

involved surveying and studies, general layout, proving of plans, designing, trial production, installation, testing, trial production, product evaluation and delivery. Our efforts enabled the whole automated production line involving 27 single machinery units and systems and 5 large control cabinets to realize joint mechanical operation and electronic procedural control from mixing materials, to mixing flour, fermentation, cutting, making dough, forming, canning, rising, baking, removing from cans, spraying oil, cooling, packaging. We retained the good habit of always being careful about quality as in producing military products in our test manufacturing work. The processing precision was higher, there was less noise, operation was reliable, and only 13 people were required to supervise the operation. Each day, 7 1/2 tons of bread could be produced. Since installation, testing and the beginning of production, over 10 propaganda units throughout the nation issued news reports and televised reports on our nation's first automatic bread production line successfully developed by our institute. People in Australia wrote to inquire about it, people from Nigeria came to negotiate, Hong Kong released news about it, and it attracted broad attention in our nation and abroad, and it was praised by large food preparation factories and higher agencies in our nation. Being unfamiliar with the bread manufacturing business, we were still able to make breakthroughs in it within a relatively short time and solve the problems of continuous automatic fermentation, automatic canning, automatic removal, and continuous operation of the whole set of facilities and process control which were not solved for a long period. We were able to do so with the help of various related sister units in the food industry, and to a large degree, because of the concrete results of applying military technology in a big way. At the same time, we applied speed testing techniques and vibration testing techniques developed for military products in the development of civilian or military and civilian instruments. After more than 3 years, we successfully developed 10 new testing instruments, and provided new equipment to solve high precision digital speed measurements of civilian rotary machinery, for rotary speed control, speeding protection, and vibration monitoring. We feel deeply that in scientific research for civilian products, appropriate transplanting of military technology can realize the good results in shortening the time for research and development, in producing more achievements, in popularizing and applying the achievements quickly, and we realized good economic results.

3. Absorb Imported Technology, Combine Learning From Foreign Nations and Our Own Innovations

To transfer foreign technology into our nation, we have greatly strengthened technical information gathering. We have recommended foreign publications and information to technical personnel and absorbed advanced technology for our institute to use. For example, our institute's testing research laboratory referred to the brief introduction of the technology of Japan's eddy current meter and successfully developed the ZGY-2 axis tracer for the Northwest Industrial University, and helped that school provide a new testing instrument in the study of rotor dynamics. We referred to the experimental information of the Lewis in-flight power device developed by NASA of the United States and successfully developed the gas pressure scanning multiple point stable pressure meter. This provided a new means of multiple point stable pressure measurement in developing military and civilian industries. We are surveying and conducting counter design calculations and experimental research in several imported pro-

ducts to utilize their advantages and develop our own new products on the basis of pre-studying the parts so as to use foreign objects for Chinese use. In scientific research in civilian products, we joined factories and enterprises to study how to digest, absorb, develop and create imported equipment on the principle of "learning, using, improving, creating." Hengdong Straw Mat Plant last year imported three kinds of prototype automatic mat weaving machines. The plant is a collective enterprise. Its technical strength is weak. Surveying and imitating products were very difficult. We took over the task of surveying, improving the type and trial production to support the light industry and to create foreign exchange. After understanding the design principles and the production technique, we cooperated closely with the factory, and we changed the automatic machine that could weave mats with interwoven flower designs and redesigned it into an automatic yarn threading machine, improved imported equipment such as the raised flower mat weaving machine by improving the straw picking mechanism, the fuel line, and the brake mechanism when the yarn breaks. We enlarged the width and satisfied the user's requirements. At present, the redesigned yarn threading, mat weaving machine has been successfully test produced and has been handed over to the factory for trial production. Other improved mat weaving machines that have been improved are being trial manufactured. They can be evaluated and inspected in May or June of this year. The success in redesigning the automatic mat weaving machines has enabled that factory to renovate its equipment and its products have become high grade products. The plant's director satisfactorily said: "With the automatic mat weaving machine, the products of our factory can step from the 1950's into the 1980's, and the sales channels of the products can enter the international market from the domestic market, this is like a tiger being given wings."

(III)

Our institute was able to make progress in efforts to carry out the "three transfers" satisfactorily in developing scientific research in civilian products and open up the situation as a result of strengthening and improving the party's leadership, changing the weak and loose situation in ideological and political work, implementing appropriate technical and economic policies, and greatly strengthening scientific research management.

1. We Continued to Deepen the Understanding of Combining Military and Civilian Endeavors, Realize the "Five Samenesses" and Carry Out Mutual Promotion

National defense science research units must not only shoulder the glorious task of developing advanced weapons and equipment and strengthen national defense, they must also support factories to follow the road of expanding reproduction by the "internal" method and stimulate the development of the national economy. For this, we must firmly implement the policy of combining military and civilian endeavors while taking the military endeavors as the key. We must insist on taking into consideration both scientific research in military and civilian products, arrange things on an overall basis, concretely realize the "five samenesses": to include both military production and civilian production in the daily agenda of the party committee, to include both in examining plans, to include both in promoting technical personnel, to include both in evaluating advanced and new models, and to include both in achievement awards. Two model

workers were cited and given scientific research achievement awards after our institute successfully developed the automatic bread production line. Because our institute followed the "five samenesses" in organizing scientific research work, we enabled scientific research in civilian products to occupy the same important position. The broad number of scientific and technical personnel and workers underwent actual training and carried out tests in scientific research in civilian products and effectively expanded the range of knowledge, improved technical standards and operating skills, and conversely, promoted the development of scientific research in military products and enabled military endeavors to lead civilian endeavors and the use of civilian endeavors to promote military endeavors. For over a year, the survey of military products imported by our institute has been basically concluded; testing and analysis and counter designing are being grasped tightly, proving of the plans for redesigned models of new products and prestudying of new machinery have begun. Prestudy of advanced components has realized achievements in stages, and improvements in speeding up the testing equipment has realized preliminary results. Breakthroughs have been made in these aspects, and new precision testing instruments have been developed successfully in a continuous way. In 1981, we completed 30 projects of scientific research in military products, and we received 8 awards for major scientific and technological achievements given by the ministry. Practice proves that as long as we follow the spirit of the "five samenesses" in our guiding ideology in organizing scientific research work, we can prevent oversight, realize mutual promotion and coordinated development of scientific research in military products and scientific research in civilian products so that we can shoulder the heavy burden of serving the national defense buildup and also contribute to the development of the national economy.

2. Select Scientific Research Projects Surrounding the "Four Services," Develop Advantages and Avoid Shortcomings, Develop Superiority

Science and technology should develop in coordination with the economy and society, and their foremost task should be to promote economic and social development. For this, our scientific research unit must select the form of civilian products closely surrounding the "four services," i.e., to serve the national defense buildup, to serve the production of consumer products, to serve technical improvement in the national economy, to serve export and the creation of foreign exchange in the selection of scientific research subjects. All urgently needed projects that provide the "four services" must be carried out whether they produce a lot of benefits or few benefits, whether they earn money or little profit and whether they guarantee a return of the cost. We must take the initiative to share the burden of the state and actively exert efforts in readjustment. Under the prerequisite of knowing the direction of service, we must insist on starting out from the actual situation, develop advantages and avoid shortcomings, develop superiority, combine our own special skills and technical characteristics to develop fully the superiority of our own technology and the potential of the equipment before we can establish ourselves in an invincible position. We believe that the advantages of the research institute are that its academic disciplines are complete, its design strength is strong, and its technical information is large. Its shortcomings are its insufficient processing strength, its unmatched cold and hot technologies, its productive capability and management level unsuitable for mass production. To develop one's own advantages and avoid one's own shortcomings, we must be

courageous in taking up creative and exploratory developmental tasks around "the four services," grasp the "difficulties" in weak areas, and bite the "bones." The products developed in this way are urgently needed by society, and we will not have to worry that they will not have "in-laws" (markets). Because our institute followed the direction of "the four services," the road has become wider because we have appropriately selected the research subjects based on scientific forecasts. The economy has become more lively, the scientific research tasks have changed from the past situation of "not having enough" to the present situation of "having too many."

3. Implement the Principle of Unified Planning and Responsibility at Each Level, Pool the Wisdom of Everyone To Fight a "People's War"

Scientific research work and tackling technical problems are like a revolutionary war, "battles can be fought only by mobilizing the masses, and only by relying on the masses." To mobilize the workers of the entire institute to join the ranks of scientific research in a big way, we used various forms to assign tasks to the right places according to the amount of work, the degree of complexity, the different economic benefits and under the principles of unified leadership, unified plans, assigning responsibility to each level, division of labor and cooperation in scientific research projects for civilian products. Everyone knows the goals clearly, everyone knows what is involved, everyone dares to act freely and develop his talent to create a situation in which everyone pools his wisdom and efforts to fight a "people's war" in scientific research in civilian products.

In the production of small commercial products, "each fought his own battle." We once organized the production of electric blankets and processed uniforms under the guidance of the business ideology that "as a large institute, we never regarded any business opportunity as too small." We distributed this work that produced only a little profit to the female workers of the institute and they became responsible. They satisfied the needs for internal supply and external demand at the time.

Our scientific research projects that could be carried out independently by the research laboratory were done by "each fighting his own battle." All subject and projects with compatible technical difficulty and developmental difficulty became the independent responsibility of the research laboratory, from the determination of the research plan, the drawing up of the research plan, to the determination of the concrete design, testing and the writing of the technical report. The laboratory fully developed the enthusiasm of its workers, their initiative and their creativity, and as a result, the period of development was short, less money was spent, the achievements quickly entered into production. For example, our institute's scientific research achievement in the development of civilian products,--the laser holographic photography device and the axis tracer--were separately developed successfully by the laboratory of material strength and the testing laboratory. We manufactured on a trial basis 15 units comprising 140 sets of the laser holographic photography device while finalizing the design. The subjects involving many disciplines have been carried out by several research laboratories "in coordinated combat." The entire production line of the automatic bread production line developed by our institute for the Wuzhou City had to be mechanically linked, and it had to use electronic

procedure control. We organized the second and fourth laboratories which had a stronger mechanical and electrical design strength to work together on the project. Because we concentrated superior forces to fight the battle to annihilate the enemy, we struggled for only 2 years and realized success.

Large and difficult scientific research subjects were carried out by organizing the entire institute to conduct a "large army corp battle." The subject of degumming of ramie carried out by our institute required continuous mechanical and semiautomatic operation from softening and combining of the raw ramie, to acid soaking, alkaline boiling, baking, dehydration, loosening, bleaching, drying, softening and winding. This was a key subject affecting the development of the whole nation's ramie textile industry. We removed the boundaries between units, organized people involved in general configuration, performance, structure, strength, electrical devices into "five armies," to form the technical backbone teams of the research laboratory, concentrated organization to tackle the problem and formed a "three dimensional battle."

Through the various methods above, we organized scientific and technical personnel not engaged in scientific research for military products or made with insufficient tasks to let them show their talent. This developed the full potential of their talent, channeled everyone's wisdom and talent into the revolutionary tide of producing civilian products and developing scientific research, carried out a "people's war" in scientific research in a wide way. The whole institute eliminated "inactive elements," and basically eliminated "free loaders." Scientific talent rapidly grew, scientific research achievements continued to emerge, and this year, there are 12 important scientific research achievements that are about to be evaluated and inspected. We feel people that in the distribution of the planned scientific research work, we must live the ideology, be free and daring, suit people to the situation, and arrange work in a versatile manner.

4. Actively Implement the Economic Responsibility System to Realize Distribution According to Work and Merit

The economic responsibility system implemented by the research institute is a system to manage scientific research by combining plan, responsibility, authority and benefits. It is centered around the goal of increasing economic gain and political responsibility. Under unified plans, the scientific research in civilian products, we established a strict responsibility system by clarifying the economic responsibility of the research laboratory, the total distribution shop and the functional departments and units to guarantee that all units are in contact and are coordinated.

While carrying out scientific research in civilian products we actively add to the quantity, the personnel, the time, the funds and continue to fully production and plan to production. The monetary awards are designated and determined by the achievements actually obtained by the scientific research. The awards have been inspected and accepted and some data have been filled. Monetary achievement in phases are given to scientific research projects that are difficult and that require a long time as long as certain major technical breakthroughs have been made. The implementation of the economic responsibility

system stimulates the scientific and technical personnel conscientiously to prove the technical and economic value of every scientific research subject and analyze its technical standard. Value engineering management techniques are used, and efforts are exerted to reduce the cost of scientific research, to shorten the period of development, to reach technical maturity, develop a feasible technology, economic rationality, visible results, and thus guarantee that every project in scientific research in civilian products undertaken by our institute is successful and is popularized and applied.

Shops that manufacture civilian products on a trial basis mainly determined the output, quality, progress, awards and punishment, and guarantee delivery of the products. According to the size of the tasks, they contracted work that generated little profit. All tasks completed ahead of schedule received increased awards and awards for all projects behind schedule were withheld. After the products were inspected, accepted and delivered, 5 percent of half of the productive value was kept. The implementation of the economic responsibility system stimulated the shops to use the best technological methods, as much as possible, establish advanced average quotas, pay attention to the quality of test production, improve productive efficiency, and each month, hard work, tangible work, skillful work were maintained.

Functional departments and offices for planning and dispatching material supplies to technical services, all carried out their duties, each performed its work, and each upheld its responsibilities. Unconditionally, they guaranteed scientific research funds for the frontline of scientific research production,

guaranteed the supply of raw materials, guaranteed the supply of fuel and power, guaranteed the supply of imported materials, guaranteed coordination and continuation of the plans. To inspect the implementation of "four guarantees and one contract," we implemented annual plans, quarterly arrangements, monthly evaluation and comparison. Departments and offices that completed the tasks will receive bonus and additional awards. The monthly awards for all departments, monthly production tasks that were delayed because of dereliction of duty by the functional departments and offices were withheld or deducted.

The implementation of the economic responsibility system stimulated related functional departments and offices to carry out, conscientiously comprehensive guidance and, strengthen the dispatching of plans. Plans for key projects were evaluated and reviewed, scientific research production was organized in time, thus eliminating the past situation in which plans were not implemented, production was without basis and work was not coordinated.

Facts prove that connecting economic responsibility, economic results and economic benefits together is a better way to improve scientific research management, and efficiency and economic benefits. Through the trial implementation of economic responsibility, we enabled the research laboratory, the special group, the shop, the shift, the department and office, and special personnel to become like a lively economic cell. Political work truly combined with scientific and technological tasks so that there was a more reliable guarantee for the scheduled completion of scientific research tasks and the implementation of scientific research contracts.

Although our institute has achieved a big step forward in developing scientific research in civilian products, this is only a preliminary, and we are far behind in satisfying the requirements of the party and the state. In the future, we must follow the party's line, and we must be fully mobilized by the Central Committee. We must increase the number of scientific and technical personnel and workers, we must realize the "three transfers" in scientific research and technology and progress one step further, find ways to truly improve scientific research management, think of ways to increase development of scientific research in civilian products. In the future we are determined to mobilize the entire institute, to unite all together, to work hard, to exert full efforts to fight, to intensify the work of the women's volleyball team, to climb the heights of science and technology, to realize new achievements, and to make new contributions!

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SCALING LAWS OF A KET IN TOKAMAK DEVICES DESCRIBED

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[Text Abstract]

Various empirical scaling laws obtained from the present tokamak are summarized and the general characteristics of these scaling laws are given. The dependence of energy characteristic times on the anomalous electron conduction coefficient is analyzed, and transport model which can be used for numerical computation is presented.

1. Introduction

Scaling laws describe the relationship between the macroscopic parameters of the tokamak and the basic parameters of the equipment. Examples of the plasma parameters are energy characteristic time, polarization E_p and I_p operation. Examples of equipment parameters are the diameter ratios, toroidal magnetic field and plasma current. Scaling laws may be either obtained from theoretical analysis or obtained from experimental data. The former is known as empirical scaling law. When the basic physical principles are not well understood, then the empirical scaling laws are especially useful. If the basic mechanisms of these empirical scaling laws can be interpreted theoretically, then the predictions of the scaling laws can be further verified. Thus these empirical laws have important application in controlled nuclear fusion.

In the past decade, controlled nuclear fusion research has made great progress in tokamak type devices. The global instability problems have been overcome. The confinement, energy conversion times of the plasmas have been improved. The large amount of experimental data. Experimental results have confirmed that the electron thermal conduction coefficients are obviously much smaller than the classical value, probably due to nonclassical mechanisms. The theoretical studies on the anomalous electron thermal conduction coefficients have so far not been able to reach any definite conclusions. Therefore, the

various scaling laws should be studied both experimentally and theoretically in order to understand the basic properties of high-temperature plasmas. This is very important for research on controlled nuclear fusion.

II. Empirical Scaling Laws

In Table 1, we have listed the energy characteristic times, plasma temperatures, maximum ion temperatures, etc. for various types of Tokamak devices. Unless specifically mentioned, we have used the following units in this paper: energy characteristic time τ_E , μsec ; density \bar{n}_e , etc., 10^{13} cm^{-3} ; plasma ion radius, R, a, cm ; plasma temperatures, T_e, T_i , etc., eV ; transverse and polar magnetic fields B_T and B_p , gauss; plasma current I_p , kiloamperes.

From the results listed in Table 1, it may be seen that the functional relationship of the energy characteristic time is different from the other parameters. In Table 2, we have listed the energy characteristic times calculated from a series of parameters and the ring current and the equipment parameters.

The results of Table 2 indicate that the energy characteristic times calculated from the same set of equipment parameters and different scaling laws vary over a factor of 50. (We note that some calculations have exceeded the range of applicability of the scaling relations.) Furthermore, the functional forms are not completely identical. For example, the relationships between energy characteristic times and plasma currents are not always the same, although there are some general rules, such as the direct proportionality between the energy characteristic time and \bar{n}_e , a , $q(a)$ and also the basic inverse proportionality with Z_{eff} (in the ninth scaling law, there is direct proportionality with Z_{eff} , but the correlation is very weak). We may express the energy characteristic time as a function of the various parameters by the following equation:

$$\tau_E \propto f(\bar{n}_e, a, I_p, T_e, Z_{\text{eff}}) I_p^{\alpha} \bar{n}_e^{\beta} a^{\gamma} q^{\delta} T_e^{\epsilon} / Z_{\text{eff}}^{\zeta} \quad (1)$$

For the case of weak correlation between the function f and the other parameters, then the range of the various parameters may be obtained from the scaling laws given in Tables 1 and 2:

$$\begin{array}{lll} -\frac{1}{2} \leq \alpha \leq 1, & \frac{1}{2} \leq \beta \leq \frac{1}{2}, & 0 \leq \gamma \leq 3, \\ 0 \leq \delta \leq 1, & 0 \leq \epsilon \leq \frac{1}{2}, & \zeta = \frac{1}{2}. \end{array}$$

Equation (1) may also be used to study the functional relationships between the energy characteristic time and a single parameter. For Ohmic heating, there are still difficulties in experimental studies on the variation of energy characteristic time with a single parameter, since experimentally we cannot vary a single parameter while keeping the others constant.

Table 1. Empirical scaling laws and the ranges of parameters.

1) No.	2) Scaling law	3) Scaling law	4) Parameters	5) Name	6) Ref.
1)	$T = B_p^{0.5} (Z_{eff}/h)^{2/3}$ $5.2 \times 10^{-10} I_p^{0.5}$ $1.2 \times 10^{-10} I_p^{0.5}$ $3.8 \times 10^{-10} I_p^{0.5}$	$T = B_p^{0.5} (Z_{eff}/h)^{2/3}$ $Z_{eff} = \left(\frac{T_e + T_i}{T_{ex}} \right)^{1/2}$ $T = Z_{eff} B_p^{0.5}$ $T_{ex} = (1.27 \pm 0.1)$ $\times \sqrt{T_e B_p^{0.5} K_p^{1/2} h / \sqrt{A}}$ $T_{ex} = (0.43 - 0.63)$ $\times \sqrt{T_e B_p^{0.5} K_p^{1/2} h / \sqrt{A}}$	$n_e < 5$ $n_{e,max} < 6$ $B_T < 50$ $I_p < 500$ $R_0 < 150, a < 35$ $0.7 < n_e < 1.3$ $1 < I < 170$ $10 < B_T < 15$	TM-3 T-3 T-4 T-10	[1-5]
2)	$T_e = 1.2 \times 10^{-10} I_p^{0.5} T_i^{0.5}$	$T_e = 316.2 \frac{(Z_{eff} I_p)^{1/2}}{a}$	$60 < R_0 < 100$ $6 < a < 23$ $16 < B_T < 50$ $0.6 < n_e < 1.4$ $10 < I_p < 300$	JFT-2 JFT-2A 7) ATC ST. ORMAK. TFR	[6]
3)	$T_e \propto I_p^{0.5} q(a)^{0.5}$ $T_e \propto I_p^{0.5} q(a)^{0.5} T_i^{0.5}$ $T_e \propto I_p^{0.5} q(a)^{0.5} T_i^{0.5}$ $T_e \propto I_p^{0.5} q(a)^{0.5} T_i^{0.5}$	$T_e \propto I_p^{0.5} q(a)^{0.5}$ $T_e \propto I_p^{0.5} q(a)^{0.5} T_i^{0.5}$ $T_e \propto I_p^{0.5} q(a)^{0.5} T_i^{0.5}$ $T_e \propto I_p^{0.5} q(a)^{0.5} T_i^{0.5}$	$1 < n_e < 45$ $I_p < 100$ $40 < B_T < 76$ $n_{e,max} = 60$ $20 < I_T < 50$ $3 < n < 40$ $100 < I_p < 600$ $1 < n < 5$ $n_{e,max} = 9$ $I_p < 150$ $q(a) \approx (2-6)$	Aicator FT JIPP-F2	[8-10]
4)	$T_e \propto I_p^{0.5}$ $Z_{eff} \sim I_p/h$	$T_e \propto I_p^{0.5}$ $Z_{eff} \sim I_p/h$	$I_p < 250$ $B_T < 24.5$ $n_e < 4$	ORMAK	[11]
5)	$T_e \propto I_p^{0.5}$ $Z_{eff} \sim I_p/h$	$T_e \propto I_p^{0.5}$ $Z_{eff} \sim I_p/h$	$70 < R_0 < 100$ $6 < a < 23$ $10 < I_p < 300$ $0.6 < n_e < 1.5$	T-3 T-4. ST ATC. ORMAK. TFR, Aic- ator, Plusator	[12]
6)	$T = T_e + \frac{n_e}{n_i} T_i$ $1.700 P_{\alpha}^{1/2} P_{\alpha}^{1/2} I_p^{1/2} h^{1/2}$	$T = T_e + \frac{n_e}{n_i} T_i$ $1.700 P_{\alpha}^{1/2} P_{\alpha}^{1/2} I_p^{1/2} h^{1/2}$	9) 10)	9) 10)	[13]
7)	$T_e \propto I_p^{0.5}$ $Z_{eff} \sim I_p/h$	$T_e \propto I_p^{0.5}$ $Z_{eff} \sim I_p/h$	$10 < R_0 < 100$ $6 < a < 23$ $10 < I_p < 300$ $0.6 < n_e < 1.5$	T-3 T-4. ST ATC. ORMAK. TFR, Aic- ator, Plusator	[14]
8)	$T_e \propto I_p^{0.5}$ $Z_{eff} \sim I_p/h$	$T_e \propto I_p^{0.5}$ $Z_{eff} \sim I_p/h$	$10 < R_0 < 100$ $6 < a < 23$ $10 < I_p < 300$ $0.6 < n_e < 1.5$	T-3 T-4. ST ATC. ORMAK. TFR, Aic- ator, Plusator	[15]

Continued on following page

Table 1, continued.

1) #	2) Energy characteristic time	3) $T_e, T_e < T_e, T_{max}$	4) Experimental parameters	5) Experimental installation	6) Reference
9	$\tau_E = 7.21 \times 10^{-11} n_e^{0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$			Alexander, ATC, T-1, ORMAK, ST. PLT, T-10, T-12	[15]
10	$\tau_E = 3 \times 10^{-11} a_p I_p \sqrt{n_e}$ $a_p \approx T_e(r) / T_e(r) \approx 1.3$ (13)			TM-3, T-3, T-4, T-10, ST. TFR, ORMAK, PLT, T-12	[16]

Key:

- | | |
|-------------------------------------|---|
| 1. Number | 9. Same as above |
| 2. Energy characteristic time | 10. Experimental data already taken and in report |
| 3. Plasma temperature | 11. Installation |
| 4. Range of experimental parameters | 12. Range of parameters |
| 5. Experimental installation | 13. Radius data |
| 6. Reference | |
| 7. Generalized to | |
| 8. Experimental data | |

Table 2. Energy characteristic times calculated from various scaling laws.

No.	Empirical scaling law	1000-10000 A, 100-1000 G, 100-1000 eV	1000-10000 A, 100-1000 G, 100-1000 eV
1	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	35.1	41.4
2	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	28	33.1
3	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	15.5	18.5
4	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	4	5
5	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	1.9	2.69
6	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	3.42	6.05
7	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	17.7	21.1
8	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	5.11	6.05
9	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	1.79	6.05
10	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	15.5	31.1
11	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	22	39.1
12	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	10.5	17.0
13	$\tau_E = 0.17 n_e^{-0.5} a^{0.5} \times R^{0.5} Z_{eff}^{0.5}$	17.9	31.1

Key: 1. parameter; 2. ring current

Most Tokamak experiments have verified or nearly verified the following scaling law for the maximum ion temperature:

$$T_{i, \max} \propto I_p B \bar{n}_e R^2 / \sqrt{A_i} \quad (2)$$

Russian workers have given the proportionality constant as 1.27 ± 0.01 from their experimental data. However, Japanese workers have found the constant to be 0.43 to 0.63 from the JFT-2 experiment. This empirical scaling law agrees completely with the functional relationships of the scaling law from new classical transport coefficients in the middle region to be discussed later.

At ORMAK, TFR and other installations, strong currents of neutral particles are injected for heating. Experiments have verified that the plasma ion temperature increase is directly proportional to the power of the neutral particle beam. For the injection powers used so far, there has been no macroscopic or microscopic instability due to the injection. The energy exchange in the injection process is basically classical in nature. Recent experiments at PLT in the United States have found that the heating and confinement laws are still valid when the power of the injected neutral particle beam exceeds the Ohmic heating power. The following relationships have been established at ORMAK¹¹:

$$\text{When } I_p = 1 \text{ kiloamp, } (\Delta T_i / P_{in}) \approx 1 \text{ eV/kW.}$$

$$\text{When } I_p = 1.75 \text{ kiloamp, } (\Delta T_i / P_{in}) = (1.4-2.5) \text{ eV/kW.}$$

The scaling law for injected beam heating as a function of plasma density has been determined at TFR^{7,18}:

$$\Delta T_i \propto n_e^{-1/2}$$

$$\text{for } n_e \text{ up to } 10^{13} \text{ particles per cm}^3.$$

When comparing the different scaling laws, it is necessary to consider their combinations in further detail. Of particular interest is the relationship between energy characteristic time and plasma density.

(c) Ion Transport and Anomalous Transport

Experimental results on Ohmic heating at the various Tokamak type installations show certain general trends: The ionic heating and loss mechanisms are classical. That is, the ions are heated by the energy exchanges in the ion-electron collisions; the energy loss is mainly due to the ion thermal conduction and diffusion from the ions. Experiments carried out so far have indicated that ions still behave classically during the injection of neutral particle beams. However, the behavior of the electrons is rather unusual. For the proper interpretation of experimental data, the thermal conduction coefficient must be nearly two orders of magnitude larger than the new classical theoretical value. So far, there is no definite

conclusion on the physical mechanism of this electron thermal conduction anomaly. Experiments have also shown that the plasma energy loss is mainly through the electrons. Thus the energy characteristic time of the plasma may be qualitatively correlated with the electron thermal conductivity as

$$\text{If } T_e = T_i, \text{ then } \tau_p \approx \tau_c \approx a^2 / [2.4^2 k_e] \quad (5)$$

$$\tau_p = \tau_c \tau_i \cdot (\tau_c + \tau_i); \quad (6)$$

$$\begin{aligned} \text{If } T_e \neq T_i, \text{ then } \tau_p &= (T_c + T_i) \tau_c \tau_i / (T_c \tau_i + T_i \tau_c) \\ &= \tau_c \quad (\text{if } T_i \tau_c \ll T_c \tau_i). \end{aligned} \quad (7)$$

At equilibrium, the energy characteristic time is the same as the energy correlation time τ_c (which measures the time required to replenish the energy):

$$\tau_c = \frac{3}{2} k (n_e T_e + n_i T_i) \cdot V / P_\Omega \quad (8)$$

where P_Ω is the Ohmic heating rate and V is the plasma volume. The quantities measured in many Tokamak experiments are either the energy correlation time given by (8) or the electron energy correlation time given by (9):

$$\tau_{E_e} = \frac{3}{2} k n_e T_e / P_\Omega \quad (9)$$

We should note that the energy characteristic time is equivalent to the characteristic time for energy loss, whereas the energy correlation time is equivalent to the characteristic time of the heating process. They are the same only for the equilibrium state. From (7) and from the definition of the polarization β_p , we may find the relationship between these two quantities:

$$\tau_c = 10^{-2} \cdot (3.0/8) \cdot R/R_p \cdot (\beta_p^2 \text{ cm/ohm}) \text{ sec}$$

where $\beta_p = 4 \times 10^{-7}$ and R_p is the plasma electrical resistance. For certain installations, scaling law of β_p is given. These two are equivalent.

Studies on plasma heating and other transport processes are carried out under conditions of macroscopic stability. Thus the conditions of stability and of equilibrium must be satisfied:

$$q(a) = \frac{2\pi}{l(a)} = \frac{1}{\mu} = \frac{5a^2 B r}{R I} \leq \frac{m}{n}, \quad (10)$$

$$\beta_p \leq (R/a), \quad (11)$$

where $l(a)$ is the angle of rotation, m and n are the mode numbers in the polar and transverse directions. Equation (11) gives the largest allowable value of β_p under macroscopic equilibrium.

1. Basic Equations

The basic equations for the analysis of plasma scaling laws are the equilibrium equations for particles and for energies. Under conditions of axial symmetry, these equations are:

$$\frac{\partial n_e}{\partial t} = \frac{1}{r} \frac{\partial}{\partial r} \left(r D_e \frac{\partial n_e}{\partial r} \right) + S_e, \quad (12)$$

$$\frac{3}{2} \frac{\partial}{\partial t} (n_e T_e) = \frac{1}{r} \frac{\partial}{\partial r} \left(r T_e D_e \frac{\partial n_e}{\partial r} \right) + \frac{1}{r} \frac{\partial}{\partial r} \left(r n_e K_e \frac{\partial T_e}{\partial r} \right) + \eta_p j^2 + w_{be} - Q_{ei} + w_r, \quad (13)$$

$$\frac{3}{2} \frac{\partial}{\partial t} (n_i T_i) = \frac{1}{r} \frac{\partial}{\partial r} \left(r T_i D_i \frac{\partial n_i}{\partial r} \right) + \frac{1}{r} \frac{\partial}{\partial r} \left(r n_i K_i \frac{\partial T_i}{\partial r} \right) + Q_{ei} + w_{bi} - w_{ci}, \quad (14)$$

In addition, the conditions of plasma current and electric neutrality

$$\frac{\partial \mu}{\partial t} = \frac{1}{r} \frac{\partial}{\partial r} \left[r \eta_p \frac{\partial (r^2 \mu)}{\partial r} \right] \quad (15)$$

and

$$n_e = \sum_i n_i Z_i \quad (16)$$

are needed so that they may be solved simultaneously with the field equations. In these equations, S_e is the source term of the electrons, Q_{ei} is the energy exchange term between electrons and ions, η_p is plasma electrical resistance, D_e and D_i are the diffusion coefficients of the electrons and the ions, K_e and K_i are the thermal conduction coefficients of the electrons and of the ions, w_{be} and w_{bi} are the heating terms of the electrons and the ions due to neutral particle beam injection, w_{ci} is the electrical charge loss due to exchange, and w_r is radiation loss. If we need to consider the presence of impurities or of neutral particles, then we must also add the conservation equations for the numbers of these particles. With reasonable simplifications, we may obtain certain scaling laws for the heating processes.

2. Maximum Electron Temperatures

The maximum electron temperature $T_{e,max}$ may be obtained from the basic equations by assuming the Ohmic heating power is completely used to heat the electrons and by assuming that there is no energy loss. The order of magnitude result is

$$T_{e,\max} = (5Z_{\text{eff}} A_0 t_0 j_0^2 / 3n(0))^{2/5} \quad (17)$$

where \cdot is the anomalous electrical resistance factor due to nonimpurities, t_0 is the characteristic time of the heating process, j_0 is the current density, and A_0 is a constant selected to give the proper dimensions or units.

3. Maximum Ion Temperature

Under the condition of pure Ohmic heating, the equation of energy equilibrium for the ions is

$$-\frac{dT_i}{dt} = A_i n_e \frac{T_e - T_i}{T_e^{3/2}} - \frac{T_i}{\tau_i} = A_i n_e \frac{f\left(\frac{T_e}{T_i}\right)}{T_i^{1/2}} - \frac{T_i}{\tau_i}, \quad (18)$$

$$f(x) = f(T_e/T_i) = \frac{x-1}{x^{3/2}}. \quad (19)$$

if we do not consider the variations in particle number densities. For Ohmic heating in Tokamaks, the variations in T_e/T_i is not great; the ratio is usually between 1.5 and 10. In this range, $f(x)$ is a slowly varying function with a maximum value of $f(x=3)=0.385$ at $x=3$. Thus the replacement of $f(x)$ by its average value would cause an error of less than 30 percent. It is therefore permissible to treat $f(x)$ as a parameter in equation (18), then equation (18) would be independent of the electron temperature. Direct integration gives the functional dependence of ion temperature on time:

$$T_i = \left\{ B_i \tau_i \left[1 - \exp\left(-\frac{3}{2} \frac{t}{\tau_i}\right) \right] + T_{i0}^{3/2} \exp\left(-\frac{3}{2} \frac{t}{\tau_i}\right) \right\}^{2/3} \quad (20)$$

where T_{i0} is the initial ion temperature. For the equilibrium state, the expression for the maximum ion temperature may be obtained from equation (18). If the ion energy characteristic time is expressed in terms of the ion thermal conductivity, then we may calculate the maximum ion temperatures for various values of the transport coefficients. If we select the new classical thermal conductivities for the middle region, then the maximum ion temperature in the middle region is

$$T_{i,\max} = 0.75^{2/3} / f(x) n_e B_T l_p R^2 Z_{\text{eff}}^{-1} / \sqrt{A_i}. \quad (21)$$

The functional relationship between maximum ion temperature and the various parameters given by equation (21) is identical to the scaling law (2) of the maximum ion temperature. Experiments from the JFT-2 Tokamak installation have verified the dependence of $T_{i,\max}$ on the $1/3$ powers of n_0 , B_T , l_p . Similarly, the maximum ion temperature in the banana-[7449 5604] region is

$$T_{i,\max} = 3.2 \times 10^{-1} (R/r)^{1/2} f(x) I_p^2 / [(A_i)^{1/2} Z_{eff}], \quad (22)$$

The proportionality of the maximum ion temperature to I_p^2 is one of the characteristics of the banana regions in Tokamaks.

When the anomalous transport is mainly due to the instability of the diffusion-trapping mode of the ions, similar methods may be used to calculate the maximum ion temperatures.¹⁵ Here, the maximum ion temperature satisfies a cubic equation with at least one real root. This root gives us the maximum ion temperature. If T_e/T_i is a parameter, then we may solve approximately for the maximum ion temperature.

$$T_{i,\max} = 7.45 (\Phi(x) \bar{n}_e^2 R^2 B_T^2 r_n^2 / 100 A_i r T_e^2)^{1/3}, \quad (23)$$

$$\Phi(x) = \Phi(T_e/T_i) = \frac{x-1}{x^{3/4}} \left(1 + \frac{1}{x} \right)^2 = (x^2 - 1)(x + 1)/x^{7/4}, \quad (24)$$

where L_n is characteristic length of the density variation. Under pure Ohmic heating conditions, $\Phi(x)$ is a slowly varying function with its maximum value at $x = 1 + \sqrt{2}$. The average value is $\langle \Phi(x) \rangle = 0.53245$. If the function is replaced by its average value, the maximum error will not exceed 35 percent. From these relations, equation (23) may be approximated by

$$T_{i,\max} = 6.809 (\bar{n}_e^2 R^2 B_T^2 r_n^2 / A_i r T_e^2)^{1/3}. \quad (25)$$

The temperature is also similar to $T_{i,\max}$ relationship for the middle region.

4. Electron Thermal Conductivity and Energy Characteristic Time

As has been mentioned previously, the ion bulk energy characteristic time may be limited by the electron thermal conductivity. In Table 3, we have listed electron thermal conductivity for various physical mechanisms. We have also given the expression for the electron energy characteristic time and also numerical characteristic times for the given parameters. It may be seen from Table 3 that there is a great diversity among the functional forms and overall values of the energy characteristic times for the different physical mechanisms.

5. Model for Ion Transport in Plasmas for Various Regions of Collision

Different space-time distributions may be obtained by using different transport coefficients. Certain transport models²⁰ have been proposed so that the theoretical results may agree with the experimental data. We have treated the ionic behavior as nearly classical, whereas the electron behavior is anomalous.

Table 1. Transport coefficients (in cm²/sec) for different mechanisms.

Physical mechanism	χ	χ	Number of series of parameters
Classical theory (ring systems)	$1.4 \times 10^{-11} \frac{Z_i^2}{T_i}$	$1.7 \times 10^{-11} \frac{Z_i^2 T_i}{Z_{eff}^2}$	100
Low classical middle region	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	99
Low classical banana region	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	441
Quasi-classical theory	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	57
Neon diffusion	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	55
Mode of dissipative drift	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	100
Mode of dissipative I	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	100
Trapping of electrons I	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	100
Mode of dissipative trapping of ions	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	100
Energy characteristic time in presence of heavy impurities	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	100
Limited by shear rate	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	100
Instability	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	$1.1 \times 10^{-11} \frac{Z_i^2 T_i}{T_i^2}$	100

where χ is the transport coefficient, Z_i is the ionization charge, T_i is the ion temperature, Z_{eff} is the effective ionization charge, T_e is the electron temperature, χ_{cl} is the classical transport coefficient, χ_{qu} is the quasi-classical transport coefficient, χ_{ne} is the neon diffusion transport coefficient, χ_{dr} is the mode of dissipative drift transport coefficient, χ_{I} is the mode of dissipative I transport coefficient, χ_{tr} is the trapping of electrons I transport coefficient, χ_{ti} is the mode of dissipative trapping of ions transport coefficient, χ_{h} is the energy characteristic time in presence of heavy impurities transport coefficient, χ_{s} is the limited by shear rate transport coefficient, χ_{i} is the instability transport coefficient.

functional relationships of the energy characteristic time with certain parameters are of the following simple form: $\tau_E = A^{\alpha}$ (where A is a certain parameter and α is a real dimensionless number). Then the energy balance equation at equilibrium may be used to find the functional relationship between the energy characteristic time and the single parameter. After taking the logarithm on both sides,

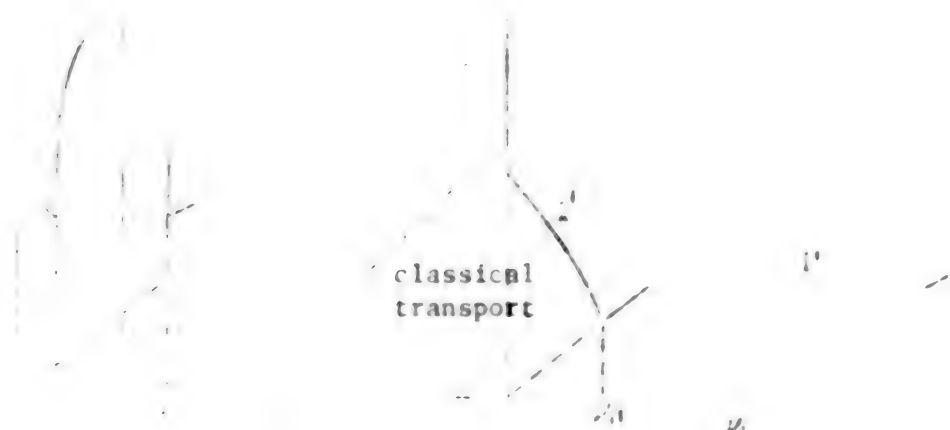


Figure 1. Schematic diagram for the transport coefficients of electrons and ions in different collision regions.

the diagram is a log-log plot. The slope of this straight line is the magnitude and the sign of α . For Ohmic heating, there is the simple relation

From our analysis it is indicated that there are general applicabilities of the scaling laws, 8, 9 and 10 in Table 1. The other scaling laws have not been analyzed. We have not analyzed the scaling laws for ion transport. Further research is still needed. There are other types of heating in the literature. Since they are quite similar to what we have analyzed, they are omitted.

FOOTNOTES

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² J. J. Duderstadt, NUCLEAR FUSION, 10, 43(1970).

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LSO: 4008/007

APPLIED SCIENCES

ARTICLE LOOKS AT INFRARED EXPERT KUANG DINGBO

See (the GUANMIN JIBAO in Chinese 11 Sep 82 p 2

Article by Li Tiegang [2587 1311 1730] and Jia Shumei [6328 2885 2653]:
"Keeping at Heart the Interests of Both One's Own Country and the Blue Skies--
Interview With Infrared Expert and Superior Party Member Kuang Dingbo
[0562 1353 3134]"

1.0 (1). Comrades, when you look up at the sky and shout in glory at the motherland's artificial earth satellites flying above, one after the other, and feel proud, have you ever thought of the scientists who have worked hard to launch these satellites into space and to keep them operating normally in orbit? Kuang Dingbo [0562 1353 3134] who is introduced here is one of them.

Kuang Dingbo is one of the earliest scientists to engage in infrared and remote sensing technology research in our nation. At the beginning of the 1960's, when concerned nations kept infrared technology very secret, the 31-year-old Kuang Dingbo led a group of scientific and technical people who were even younger than he as they overcome difficulties and began exploring infrared technology. After several years of efforts, they developed a series of infrared instruments for infrared searching, infrared tracking, infrared directional observation and infrared distance measurement. These filled the blank in our nation's infrared technology. The satellite attitude sensor is indispensable in maintaining the correct attitude of an artificial satellite in orbit so that it can perform effectively. It is called the "eye" of the satellite. Kuang Dingbo and other comrades together developed six different satellite attitude sensors. All of the satellites launched by our nation have used these instruments provided by them. Kuang Dingbo therefore has been called "the man who installs the 'eye' of artificial satellites."

In recent years, he foresees the broad future in developing remote sensing technology. Together with other comrades, he suggested that leading departments launch the study of remote sensing research. This was enthusiastically supported by the higher leadership. He became one of the responsible persons of the whole group in the development of new types of remote sensing devices. By the aid of all the comrades of the scientific research group, courageously overcome difficulties, improved the resolution and other properties of the instruments and the results. He was praised and awarded many times by the National Science Conference, the Shanghai Science Conference, the Chinese Academy of Sciences, the National Defense Scientific Committee and such leading agencies.

Kuang Dingbo is in the forefront in leading the efforts to overcome difficulties in scientific research. Politically, he has served as a vanguard model member of the Communist Party. During the more than 20 years as a member of the Communist Party, he has always suffered hardships before enjoying pleasures. He gave the glory to others and kept the difficulties for himself. When he realized achievements in scientific research, he first let his subordinate comrades write the articles and reports. In his own summary he wrote that he always evaluated fully the contributions of the collective and the contributions of other comrades. When he talked about himself, he frequently said: "In the wide expanse of the universe, the solar system is insignificant, and a person's function is even more insignificant. Scientific research achievements are realized by common efforts and the achievements should be the contributions of the collective." He frequently mingles with the masses. When his graduate students encountered difficulty in their thesis, he would personally go to the science and technology information departments in Beijing and Shanghai to look up references and find information for them. At night, he stays with his students and conducts astronomical experiments. When the street lamps are too bright and when they affect observations, he will personally climb up the poles and use his own clothes to cover up the light bulb and then climb down to join the others. His every word and every act have established him as a model party member and scientist before the masses. Last year, on the eve of "1 July," he was evaluated and selected as an outstanding party member and he was praised by the party group of the Shanghai Branch of the Chinese Academy of Sciences. This year's "1 July," he was again recommended as an outstanding party member. He attended the discussion meeting of outstanding party members of the whole city sponsored by the organizational department and the propaganda department of the Shanghai City Committee of the Communist Party of China and he was praised.



Kuang Dingbo is testing the satellite attitude sensor.

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4) Through the adoption of hardware and software technical measures, the system's capability of resisting interference has been strengthened to permit it to operate reliably under unstable current network conditions. After hearing the report on the system's design and test situation, those participating in the appraisal conference conducted on-the-spot investigations, tests, and examinations of the capability to resist interference, reliability, and other capabilities. They unanimously held that the microcomputer program control system also has "good technical characteristics, is stable and reliable, easy to adjust, test, and operate, and low in price." "Cutting tools in storage can be controlled without the use of cutting tool traces, thus reliably solving the accuracy problem of cutting tool selection for the processing center machine tools." "This system is the first of its kind used in China for controlling the support capabilities of processing center machine tools. With extensive software capability, the system is at the domestic advanced level."

All delegates also discussed enthusiastically the scope of applications of the system. They were of the opinion that, because making the system general purpose was already well considered at the time of design, not only can it be used for supplementary control of processing center machine tools, but is also suitable for use with industrial robots or automated lines, light industrial and textile machinery, foundry machinery, and so on. They recommended popularizing its use to promote the development of automation technology in China's machine-building industry. (Adopted by the Research Section)

8114

Doc: 8003/114

Author: LI, Shuren [1945-2593]
S. H. Li [1945-2593]

From: Institute of Computer Technology, Chinese Academy of Sciences

Title: The Port of Analysis of UNIX Operating System

Address: Beijing 100080 TIANJIN YU FAZHAN [COMPUTER RESEARCH AND DEVELOPMENT]
In Chinese. 1984. 104 p. 1-44, inside backcover

TEXT OF ENGLISH ABSTRACT: In this report, the source code of UNIX Operating System (kernel) (level 1) is analyzed and its data structure described; and almost all its routines (programs) are flowcharted. The purpose of the report is to explain clearly the functions, architecture, and design ideas of UNIX Operating System, so that it can be used as a reference book for studying the UNIX System and teaching operating systems. The report has been taught in some institutes and universities of China. The contents of the report are as follows: (1) The functions and architecture of UNIX Operating System (p 4); (2) The memory and process management (p 20); (3) The interrupt, trap, and software interrupt (p 28); (4) The manipulation of buffer and block-oriented I/O system (p 43). This report is to be distributed.

File

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AUTHOR: CHEN Zhaobo [7115 5126 0591]
 XIE Youxin [6200 0147 2411]
 WAN Guoliang [8001 0940 5324]
 JI Shufan [1303 2895 5672]
 WANG Canlin [3769 3503 2051]
 FENG Xiheng [6931 3301]

ORG: All of Beijing Research Institute of Uranium Geology

TITLE: "Uranium Deposits in Mesozoic Volcanics in Southeast China"

SOURCE: Beijing DIZHI XUEBAO [ACTA GEOLOGICA SINICA] in Chinese No 3, 1982
 pp 235-243

TEXT OF ENGLISH ABSTRACT: Vein type uranium deposit in volcanic rocks is one of the main types of important economic uranium deposits in China. The deposits widely distributed in acidic (felsic) volcanics in SE China are representative of this type. This paper briefly presents the main geological characteristics and ore-controlling factors, as well as the regional designatory criteria. The upper Jurassic-Cretaceous continental volcanic sequence is mainly composed of rhyolitic volcanic rocks. The Rb-Sr isochrone age is about 140-130 m.y. The initial Sr^{87}/Sr^{86} ratio varies from 0.7089 to 0.7121. The volcanism is controlled by NE- and NW- trending fault systems. Big calderas usually occur at the intersection of the 2 fault systems. The petrographic, petrochemical, and geochemical results show that the acidic volcanics in SE China did not originate from differentiation of mantle, but were

[continuation of DIZHI XUEBAO No 3, 1982 pp 235-243]

probably products of remelting of middle and lower parts of sial as a result of strong interaction between the Asian continental margin and the Kula-Pacific plate in Mesozoic. It seems that the high uranium abundance in Mesozoic acidic igneous rocks in SE China and the wide distribution of vein-type uranium deposits in this region are due to the existence of uranium rich horizons in the old metasediments that underwent remelting. Most of the uranium deposits are concentrated in the centers of volcanic activity, i.e. caldera and other forms of volcanic basins and form uranium ore field of different form. Generally, uranium deposits are located at the intersection of postvolcanic fracture zones with various volcanic structures such as ring structures, collapse structures, craters, breccia pipes, etc. The orebodies have various shapes, including stratiform, big vein, pod, as well as swarm of parallel veinlets. The physico-mechanical properties of different volcanic rocks play an important part in the localization of uranium orebodies. Uranium deposits in volcanic rocks can be divided into 3 geochemical types: (1) Dickite type formed by strongly acidic hydrothermals; (2) Albite type formed by alkaline hydrothermals; and (3) hydromica type formed by weakly acidic hydrothermals. The 3 types possess their own characteristic mineral associations and wallrock alterations. This paper also presents a brief discussion on the isotopic age, temperature and depth of uranium ore formation, as well as characteristic associated elements in the ore. On the basis of exploration experience and of metallogenic studies, some preliminary determination criteria for the prospecting of uranium deposits in volcanic rocks are discussed.

Author: [illegible]

Title: [illegible]

Subject: [illegible]

Keywords: [illegible]

Abstract: [illegible]

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On the subject of nitriding in Chinese No 8, 25 Aug

Comrade Li Wen reported by the 2 authors res-
ults of the work performed on thin layer gas-
nitriding simultaneous carburizing and nitriding.
The Labor Institute of Shaanxi Province, con-
sists of 20 delegates representing 93
enterprises in attendance. Comrades
Li Wen introduced the theory and the method
of nitriding and visited Shaanxi Sewing Machine Plant
to see the advantages of nitriding over the
old method of nitriding. A conference on the ap-
plication of nitriding controlling gage was called by
the Labor Institute on 27 May at Shanghai He-
nan. The gage is the product of Taiyuan Radio Plant
and may be used to control
the quality of heat treated products may thus

AIRTEL: None

INFO: None

TITLE: "Contract signed to produce a lightweight cross-country motor vehicle for the People's Liberation Army (PLA) and the Chinese Navy"

SOURCE: Tianjin Evening News (TJEN) (1974) (1974) (1974) in Chinese

SUBJECT: An agreement is reported to have been reached between Beijing Automobile Manufacturing Plant and the British Leyland International Company Ltd. for long term cooperative production of a four-wheel drive, light-weight, multi-purpose cross-country vehicle. The agreement states that Beijing Automobile Manufacturing Plant will manufacture the body, the chassis, and be responsible for assembly; the British Leyland Company will supply the engine, the transmission, and accessories, and be responsible for testing the vehicle to the international market. It is also reported that the diesel oil consumption of this vehicle will be only 50 percent less than that of the GAZ-66 originally produced by Beijing Automobile Manufacturing Plant; therefore, the new vehicle will definitely improve the capability of China's light cross-country cars of competing in the international market. This vehicle is said to start production in August this year.

AIRTEL: None

INFO: None

TITLE: "Soviet Union Energy Department - 1974-1975 Work Plan"

SOURCE: Tianjin Evening News (TJEN) (1974) (1974) (1974) in Chinese

SUBJECT: The Soviet Union Energy Department has issued a working program for 1974-1975. The program is aimed at increasing the efficiency of the energy sector and improving the quality of the energy supply. The program is divided into two main parts: the first part deals with the development of the energy sector and the second part deals with the improvement of the energy supply. The program is based on the following principles: the first principle is to increase the efficiency of the energy sector; the second principle is to improve the quality of the energy supply; the third principle is to develop the energy sector in a balanced way; the fourth principle is to improve the energy supply in a balanced way. The program is aimed at increasing the efficiency of the energy sector and improving the quality of the energy supply. The program is based on the following principles: the first principle is to increase the efficiency of the energy sector; the second principle is to improve the quality of the energy supply; the third principle is to develop the energy sector in a balanced way; the fourth principle is to improve the energy supply in a balanced way. The program is aimed at increasing the efficiency of the energy sector and improving the quality of the energy supply. The program is based on the following principles: the first principle is to increase the efficiency of the energy sector; the second principle is to improve the quality of the energy supply; the third principle is to develop the energy sector in a balanced way; the fourth principle is to improve the energy supply in a balanced way.

AIRTEL: None

Other Principles of Study of Mechanical Engineering

MEMBER, AMERICAN SOCIETY OF MECHANICAL ENGINEERING

As a result, the following conditions must be met:

1924, of China Society of Mechanical Engineering, Powder Conference and its 4th National Powder Conference in Shanghai Province for a duration of 10 days. This time will include metallic powder, refractory resistant materials, cast alloys, electrical, physical and chemical property tests, in respect of the Powder Metallurgy Society and its 10th Anniversary Conference and the 10th Anniversary Conference and the 10th Anniversary Conference that have not yet submitted their reports to the Shanghai Municipal Government. All these organizations are invited to send their representatives to the conference during the conference.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

1910-11-10

At the conclusion of the Joint Society of Machine Tool Society of Mechanical Engineering held a joint symposium. Experience was held on the first day of the Joint Society of Machine Tool Society, Shen Yang, Henan University. The chief committee members presented reports of the work of the past 10 months. During the symposium, 10 papers and abstracts of these papers have been compiled. The symposium served the purpose of reviewing the results of joint branch societies and promoting inter-group

Title: What and How in Socialization: Data on Parental Involvement

© 2004 American Psychological Association 0893-3200/04/\$12.00 DOI: 10.1037/0893-3200.18.4.572

Abstract: With rapid industrialization, the science of the standardization and quality policy in China, its development started rather late. The theory, principles, and methods of studying related aspects are not yet completely mastered and there is very little experience in this work. This paper reviews the standardization work in the mining machinery industry in the past 2 decades, and its accomplishments in the 1950s-1960s, 1970-1980, and 1980-present. The outstanding problems of strictly defining objectives of standardization, the relationship between standardization and production, and such concepts of standardization as parameters, parts, quality, reliability, maintenance cycle, and useful life are discussed. Finally, several viewpoints, including the adoption of international standards (ISO), gradual introduction of specialized items and eventual formation of a system of standards, the establishment of a standard review committee and a center for inspection, and strengthening the work of theoretical research on standardization, are proposed.

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AUTHOR: YAN Rulin [0917 1172 2841]
HONG Lingxian [31630407 0103]
ZHANG Gaixing [1725 6299 5261]
CHENG Yaosheng [6774 5063 1504]

ORG: Parasitology Research Laboratory, Department of Biology, Xiamen University

TITLE: "Studies on the Epidemiology of Hookworm Disease in Fujian Province, China"

SOURCE: Xiamen XIAMEN DAXUE XUEBAO--XIAMEN KEJUE BAN [ACTA UNIVERSITATIS AMOENSIS] in Chinese Vol. 1, 1982 pp 359-366

TEXT OF ENGLISH ABSTRACT: During the period of 1977-1980, a general survey on the epidemiology of hookworm disease was carried out in Fujian, China; 700 peasants from the endemic areas of 6 districts namely: Jongsan, Changpu, Changping, Xiapu, Jianou, and Youxi were examined and 302 found to be infected with hookworm. The infection rate varied from 10.91 to 51.30 percent, with an average of 39.35 percent. The sex ratio appeared to be higher for males (43.14 percent) than females (33.05 percent) and the majority of the infected cases, as observed in age records, appeared to belong to the 18-45 age group (54.24 percent.) According to our field surveys, there are 2 hookworm species involved in these cases: Ancylostoma duodenale and Necator americanus; in the endemic areas the majority of hookworm cases were infected with Necator americanus. The proportion between the Ancylostoma duodenale and Necator americanus infection was 1 : 4.51. It was found that hookworm

[continuation of XIAMEN DAXUE XUEBAO--XIAMEN KEJUE BAN No 3, 1982 pp 359-366]

Infections prevailing in the endemic areas of Fujian were closely related to the cultivation of sweet potato, vegetables, and other crops fertilized with fecal manure. The control measures of hookworm disease are briefly discussed at the end of the paper.

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AUTHOR: WEI Xuehuan [7614 1331 3883]
SUN Fuan [1327 4395 1344]
LI Mingzhe [2621 2404 0772]
ZHU Ye [2612 6851]

ORG: All of Research Institute of Acoustics, Chinese Academy of Sciences

TITLE: "A Variable Waveform Sonar Signal Generator"

SOURCE: Beijing YIQI YIBIAO XUEBAO [CHINESE JOURNAL OF SCIENTIFIC INSTRUMENT]
in Chinese No 3, Aug 82 pp 242-248

TEXT OF ENGLISH ABSTRACT: A multi-waveform sonar signal generator is described in this paper. The generator can produce two kinds of signals: one is the signal with fixed waveform and the other is with arbitrary waveform. The signals with fixed waveform include parametric variable CW, LFM, LSFM (linear step frequency modulated) and PCW (phased-coded waveform) signals. The arbitrary signals might be either amplitude-phase form or orthogonal form, produced by two digital waveform circuits.

AUTHOR: WANG Li [3769 3810]
WANG Shuhui [3769 3219 1979]
WEI Yaorong [7614 5069 2837]

ORG: All of Scientific Instrument Factory, Chinese Academy of Sciences

TITLE: "Ion Microprobe Analysis and Neutral Particle Beam"

SOURCE: Beijing YIQI YIBIAO XUEBAO [CHINESE JOURNAL OF SCIENTIFIC INSTRUMENT]
in Chinese No 3, Aug 82 pp 310-316

TEXT OF ENGLISH ABSTRACT: This paper reports results of experiments on neutral particle beam using the national production ion microprobe mass analyzer model LT-1. This paper describes the measuring method of density of neutral particle beam. The neutral particle beam used for specimen bombardment is generated by a duoplasmatron source and accelerated to 16 KeV. Specimens for test include conductors, semiconductors and insulators. Results of the tests on insulator glass specimen under neutral particle beam bombardment, show itself very low in sensitivity, as compared to those under negative primary ion bombardment. Experiments also show that the presence of neutral particles in the primary ion beam would be harmful to mass resolution and analysis of micrometer area. These imply that the primary ion beam should be filtered to avoid the neutrals.

Q168

CSU: 4009/04

AUTHOR: DU Guotong [2659 0948 0681]
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DENG Ximin [6772 1585 2404]
MIAO Zhongli [5379 1813 4409]
GAO Dingsan [7559 7844 0005]

ORG: All of Department of Semiconductors, Xiamen University

TITLE: "Characteristics of Semiconductor Lasers With Short Cavity"

SOURCE: Changchun JILIN DAXUE ZIRAN KEXUE XUEBAO [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS JILINENSIS] in Chinese No 3, 1982 pp 82-88

TEXT OF ENGLISH ABSTRACT: This paper reports experimental study of the characteristics of semiconductor lasers with the short cavity. These experiments showed that the lasers with the short cavity length operate easily in steady single longitudinal mode and have the characteristics of lower threshold current and higher external differential quantum efficiency.

This paper was received for publication on 11 Dec 81.

AUTHOR: QUAN Baofu [0356 1405 1381]
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ORG: All of Department of Semiconductors, Xiamen University

TITLE: " $\text{Ga}_{1-x}\text{Al}_x\text{As/GaAs}$ DH Lasers Made by Secondary Source Solutions"

SOURCE: Changchun JILIN DAXUE ZIRAN KEXUE XUEBAO [ACTA SCIENTIARUM NATURALIUM UNIVERSITATIS JILINENSIS] in Chinese No 3, 1982 pp 89-93

TEXT OF ENGLISH ABSTRACT: This paper reports the fabrication of the oxide isolated stripe-geometry lasers by $\text{Ga}_{1-x}\text{Al}_x\text{As/GaAs}$ LPE secondary source solutions. The variation of compositions and concentrations in the epitaxial layers made by primary and secondary source solutions was compared. The main characteristics of the lasers made by primary and secondary source solutions were measured. Experimental results showed that the main characteristics of the lasers made by primary and secondary source solutions on threshold current; transmitted power and external differential quantum efficiency were comparable. The position of dominant peak of the emission spectrum slightly shifted towards shorter wavelength.

This paper was received for publication on 11 Dec 81.

6168

CSO: 4009/05

AUTHOR: ZHANG Shufan [1728 2579 5400]

ORG: Shenyang Research Institute of Vacuum Technology

TITLE: "Positively Adopt and Use International Standards to Promote China's Work of Formulating Vacuum Standards"

SOURCE: Shenyang ZHENKONG [VACUUM] in Chinese No 4, 25 Aug 82 pp 46-49

ABSTRACT: As documents issued by the National Economic Committee, the National Science Committee, and the National Bureau of Standards have pointed out if the products of China are to compete on the international market it is extremely necessary to speed up the work of formulating standards. The adoption and use of international (ISO) standards have become the general tendency all over the world because these ISO standards are for the purpose of harmonizing the standards of all the countries, promoting trade, helping to develop the capability of interchange of parts of products among member nations to facilitate specialization and cooperation. The ultimate and highest goal of standardization work is; therefore, to achieve international harmony regarding all technical problems resulting from the exchange of labor and materials among different countries of the world. With respect to the vacuum specialty, the following characteristics of the international standard are discussed: (1) Numerical serialization of parameters is preferred; (2) The standard should be extensively applicable; (3) Continuous issuance of standards for each segment; and (4) Emphasizing precision of each standard formulated. Aside from nomenclature and graphic symbols, there are yet no national standards in vacuum technology in China. The paper urges all concerned to learn the international standards so as to promote standardization work in China.

AUTHOR: DU Jingzhong [2659 2529 1813]
DONG Zhenxi [5576 2182 0823]

ORG: None

TITLE: "Successful Manufacture of China's First Magnetic Controlled Splash Film Plating Machine to Make Mirrors"

SOURCE: Shenyang ZHENKONG [VACUUM] in Chinese No 4, 25 Aug 82 backcover

ABSTRACT: Shenyang Research Institute of Vacuum Technology applied the magnetic controlled splash film plating technique in the production of mirrors for civilian use and succeeded in making China's first magnetic controlled splash film plating machine for making mirrors, the DJC-6 model. Requested by Liaoning Provincial Bureau of Machine Industry, the Shenyang Municipal Bureau of Machinery and Electricity called a certification conference in 30 Jul-2 Aug 82 to evaluate the machine. More than 100 delegates and specialists of universities, research organizations, and vacuum equipment factories attended. All agreed that the DJC-6 provides the equipment and advanced technique to use aluminum instead of silver to make mirrors for civilian use. The machine is suitable for large scale production of mirrors of good quality, with a cost reduction of about 20 percent. In manufacturing 20,000 m² of mirrors per year with this machine, a total of 40-50 kg of tungsten filament may be saved as well.

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CSO: 4009/06

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